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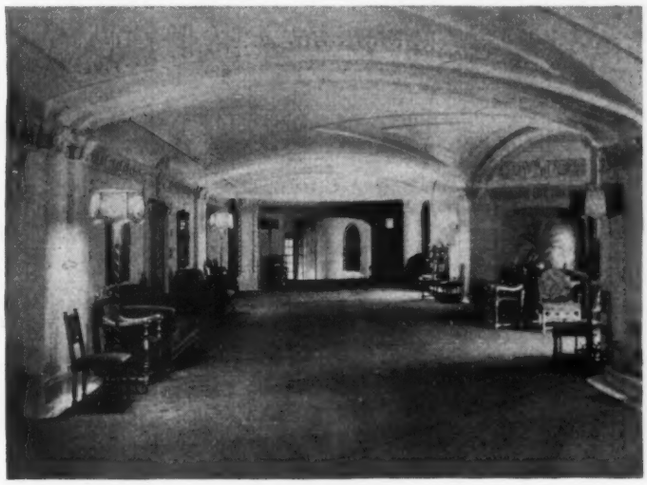

AUGUST 9, 1930

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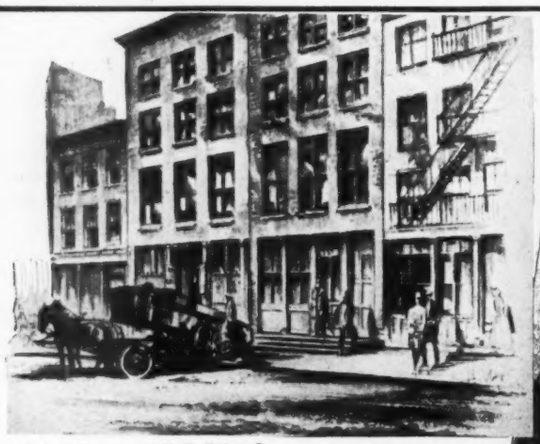

Pictures by Courtesy of N. Y. Edison Co.

In the days when the original Pearl Street Station was a world marvel OKONITE was being installed in buildings in New York City. That wire is still being used in some of the buildings which stand today.

THE chemical and physical characteristics of rubber are so complex that rubber insulating compounds are purchased either on faith or under specifications which identify only a few known elements of their dielectric structure.

Ability of an insulation to retain its insulating value over many years is as important as its original dielectric strength. Attempts to predetermine performance by accelerated life tests in the laboratory are uncertain as compared to known results secured in actual service.

Only the actual passing of years will prove the aging ability of rubber insulation.

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OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION

ELECTRICAL WORLD

for the Week Ending

August 9, 1930

New York offered $5,000,000 rate cut

Los Angeles delays power bond vote

Water shortage grows more acute

Arizona to continue Boulder Dam fight

—MERCHANDISING by utilities again upheld in Pennsylvania as State Supreme Court declares it to be "a legitimate mode of extending the company's business."

—RATE CUT of $5,000,000 to New York City users offered on basis of establishing fixed charge. Means increase in bills of 60 per cent of residential consumers, and fight looms.

—HYDRO shortages throughout country become generally serious as steam stations take up "white coal's burden" and save the day. Trouble avoided through adequate reserves.

—INSULATING-OIL studies show interrelation of acidity, moisture and sludging difficult of determination, but oxygen is proved chief source of trouble.

—LIGHTNING protection has been studied carefully abroad, too. German investigator emphasizes importance of avoiding direct strokes and recommends grounding all towers and using protective condensers.

—PASSAMAQUODDY hydro development again in the news as Hoover sanctions appropriation for international study. Effect upon Canadian and United States fisheries is question now to be considered.

—GREAT BRITAIN accepts electrification as a tool in industrial rehabilitation and progress. Comprehensive plan affecting 94 per cent of area and 98 per cent of population is proceeding rapidly.

—RAILROAD electrification now developing largely on economy basis, is conclusion of one observer, who shows huge operating savings for users according to I.C.C. accounting system.

NEWS OF THE WEEK

Sloan for 5-Cent Rate Plus 60 Cents—Boston and Philadelphia Rates Cut

HEAVY cuts in the rates for household electricity will go into effect on September 1 in Boston and Philadelphia. In New York City, also, as told last week, rates are again in the foreground of discussion, with the likelihood of a substantial reduction in the early future, to the larger domestic consumers at any rate, provided that the Public Service Commission and the allied companies can agree.

On the basis of present consumption the Boston saving is put at $1,300,000 a year and the Philadelphia reduction at $1,750,000. Matthew S. Sloan, president of the New York Edison and its allied companies, puts the difference between income from present rates and that from a new tariff proposed by him at $5,396,000 in favor of the customers. Mr. Sloan's proposal is to cut the 7-cent kilowatt-hour rate now charged by the company to 5 cents, but to add to the bill of every customer a service charge of 60 cents. This would leave untouched the total for a customer using exactly 30 kw.-hr. a month, adding to all bills for consumption of less than that amount of energy and reducing all bills for more.

Reception of Sloan proposal

Criticism of Mr. Sloan's proposed service charge (which is discussed on pages 257 and 258 of this issue), chiefly on the ground that it will operate to the disadvantage of a million small domestic consumers, whose bills will be increased instead of diminished, has already come from the Utility Consumers' League of New York, the Community Councils of New York, spokesmen for the Socialist party and others, including Dr. John Bauer, city rate expert, and Prof. James C. Bonbright of Columbia University, who was one of the minority members of the recent legislative investigating commission. Governor Roosevelt, in a letter addressed to Milo R. Maltbie, chairman of the New York Public Service Commission, praises Mr. Sloan's conciliatory attitude, but also dissents from the plan of putting an "additional burden on the small consumer."

Other features of the rate discussion concern the submetering companies, which, according to some critics of Mr. Sloan's proposal, would find the proposed rates extremely profitable because of the service charge permitted, while other critics maintain that the new schedule would operate to their disadvantage, and the announcement of Governor Roosevelt that negotiations are under way with upstate companies for a revision of their rates also.

Chairman Maltbie announced that hearings on the New York Edison proposal would begin on Tuesday morning, August 12, in New York. The whole commission is expected to sit except Mr. Van Namee, who is in Europe on vacation.

Rate cut of $1,300,000 ordered for Boston Edison

A rate cut estimated to reduce the operating revenues of the Edison Electric Illuminating Company of Boston by approximately $1,300,000 per year on the present volume of business will become effective September 1 by order of the Massachusetts Department of Public Utilities. The order follows conclusion of a protracted investigation of the company's rates by the board and

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FLOODLIGHTING DEMONSTRATED AS AN ELEMENT IN WARFARE

—Underwood & Underwood.

This view taken at Chicago during a recent spectacular army show in that city shows the important part borne by floodlighting in modern warfare. The photograph was made during a mock aërial attack.

petitions by Boston and other municipalities for lower prices. The maximum rate under this order is 7.5 cents per kilowatt-hour on the company's general rate "A," residence rate "B" (a promotional area rate), and general (small) power rate "F." The present maximum is 8.5 cents. Both maxima include certain lamp renewals.

An interesting feature of the case was that the reproduction theory of rate basing was not involved. The company argued that it was entitled as a matter of law to earn a return sufficient to pay the present dividends or more ($13.60 per share per year, par of stock $100). The commission believes that the company can earn at least $12 per share in dividends after depreciation and can maintain the market value of its stock at at least $215 per share, the highest price at which, under the Massachusetts law, the regulating body has required it to be offered to stockholders. The board is of the opinion that the gain in business resulting from the reduction will enable the company to maintain its credit unimpaired and that the decrease in the cost of living represented in the reduction will to a corresponding degree relieve the strain upon industries. It appears in the finding of the commission that the board considers that prevailing maximum rates at Worcester, Springfield and Cambridge, all under other than Edison management, represent an objective toward which Boston Edison rates should be regulated. The rates are virtually the same as the reduced rates which, at the suggestion of the department, have been filed by the Quincy Electric Light & Power Company, effective September 1.

Philadelphia Electric Company announces reduced schedules

Announcement was made on August 1 by the Philadelphia Electric Company of new city and suburban schedules to be effective September 1. President William H. Taylor estimated that the aggregate saving would be about $1,750,000 a year.

The new city rate will be 75 cents a month for the first 10 kw.-hr., 6 cents for the next 38 kw.-hr. and 3 cents for all excess over 48 kw.-hr. a month. The present rate is 8 cents per kilowatt-hour for the first 36 kw.-hr. over a three-month period, 6 cents for the next 108 kw.-hr. and 3 cents for all over the 144-hour total for three months.

Instead of quarterly bills the company will send out monthly statements, but the change will not be in effect completely before January, Mr. Taylor said. The present minimum charge of 75 cents will be retained and included in the first 10 kw.-hr.

The cut in the suburban rates, effective everywhere except in the Delaware County division, which is already on the approved 8-cent rate, amounts to 1 cent an hour.

A half-cent reduction from the top price of 7½ cents, to 7 cents per kilowatt-hour, is made for retail power service and is effective on the first 48 hours to customers each month. A new scale is also made on commercial lighting, reducing the hourly rate on the first 48 hours' service from 8 cents to 7½ cents per hour.

▼

Rate Cuts Predicted for Northern Ohio

REDUCTION of electric rates to domestic consumers is predicted by officials of the Ohio Edison Company. Although the reduction is not held to be likely this year, it is prophesied that when new franchises are drawn up there may be at least a 25 per cent reduction in northern Ohio. The saving made by the recent merger will eventually benefit the consumer, according to the officials, and, in addition, light and power costs are being reduced by the improvement of transmission and distribution systems.

The City Council of Toledo has approved a move for an investigation of electric rates to small consumers.

EFFICIENCY AND PICTURESQUENESS UNITE

Charles City, Iowa, still has its romantic-looking old mill, but the Iowa Public Service Company has now an efficient generating unit, as the result of removing creaking old gears of wood and installing modern equipment

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League Men Meet at Association Island

THE annual conference of the officials of local electrical leagues was held on Association Island, Henderson Harbor, N. Y., from Thursday, July 31, to Monday last, at Camp Co-operation X. One hundred and sixty delegates participated in a program that embraced the scope of league work.

G. W. Weston of Kansas City was elected chairman of the League Council to serve for the coming year and J. J. Caddigan of Boston vice-chairman. The new League Council is as follows:

New England—J. J. Caddigan, H. E. Dawson.
Eastern—D. C. Birdsell, J. H. Van Aernam, Earl Whitehorne.
East Central—J. E. North, L. E. Coen.
Middle Atlantic—H. A. Brooks.
Southeastern—J. J. Brennan, B. H. Martin.
Great Lakes—R. S. Steffen, W. B. Zerras, Roy Thurman.
North Central—John S. Hogan.
Middle West—G. W. Weston, C. F. Farley.
Southwestern—W. E. Clement, W. J. Aicklen, Jr.
Rocky Mountain—J. J. Cooper.
Northwest—R. E. Folland.
Pacific Coast—H. H. Courtright.
Canada—E. W. Ashworth, J. G. Glassco, James Lightbody.

Drought Reduces Output of Susquehanna Plants

CURTAILMENT of production by the two great hydro-electric plants on the Susquehanna River—at Holtwood, Pa., and Conowingo, Md., owned respectively by the Pennsylvania Water & Power Company and the Philadelphia Electric Company—is reported as one of the results of low water caused by the long-continued drought. The decrease in output is said to have reached 50 per cent. Since both plants belong to great systems with abundant steam generating resources, no difficulty in meeting customers' requirements, less at this season of the year than usual, is involved.

Answering a question from the ELECTRICAL WORLD, F. A. Allner, general superintendent Pennsylvania Water & Power Company, said at Baltimore on Wednesday of this week:

"Energy available at Holtwood from river flow during the first seven months of 1930 was only about 2 per cent less than average expectancy. The Holtwood usable run-off during July was about 30 per cent below average. The lowest consecutive seven-day average in July was 5,780 sec.-ft., as compared with a previous seven-day minimum of 4,710 sec.-ft. during twenty years. Holtwood operation run-off during August so far is still about 10 per cent higher than the minimum observed in August of previous years. From present indications we do not expect extreme low records either in accumulated annual energy or in minimum run-off."

H. B. Bryans, vice-president Philadelphia Electric Company, said: "The water available for generation at Conowingo for the first seven months of this year has been 7 per cent below the average year."

▼

Arizona Will Persist in Boulder Dam Fight

THAT Arizona will fight the Boulder Dam project to the bitter end now seems almost certain, despite optimistic reports to the contrary. E. B. Pederson, Attorney-General of Arizona, said while in Washington last week that suit would be filed before the next session of the United States Supreme Court on grounds of unconstitutionality. Mr. Pederson put forth as one of his main arguments that the contracts signed by the Interior Department will provide insufficient funds to finance the project as required by law. The Comptroller-General has been asked to rule against further expenditures for construction preliminaries till federal funds are more fully safeguarded.

Secretary Wilbur minimizes this legal obstruction, expressing confidence that the constitutionality of the act will be upheld.

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Los Angeles Postpones Vote on Bond Issue

LOS ANGELES' three-year construction program, including right-of-way for Boulder Canyon transmission lines, for which a nineteen-million-dollar bond issue is sought, will come before the voters for approval on November 4, instead of August 26, as at first proposed. As already reported (ELECTRICAL WORLD, July 26, page 151), $31,000,000 will be required, but $12,000,000 is to come out of revenue.

Major items and their cost include: Two small power plants with total capacity of 9,100 kw. in Owens Valley and 222-mile, 110-kv. steel-tower transmission line, $4,885,000; third unit in plant No. 2 on the aqueduct, 14,000 kw., $925,000; additions and improvements to present generation and transmission system within the city, $3,725,000; new line and receiving substation, $3,075,000; additions to city distribution system, largely preparatory to distribution of Boulder Canyon power, $14,665,000; general equipment, warehouses, shops, etc., $1,200,000; Boulder Canyon transmission rights-of-way and attendant engineering, $2,525,000.

▲

THE BUSY WELDER

Electric arc welders have become ubiquitous. This one is stitching tank seams inside a large circuit breaker at the Philadelphia plant of the General Electric Company.

Pennsylvania High Court Sustains Merchandising

QUO warranto proceedings brought by the Attorney-General of Pennsylvania against the Philadelphia Electric Company to determine whether the utility has the right to sell electrical appliances to its customers as an incident to its sale of energy have elicited from the Pennsylvania Supreme Court a judgment sustaining a lower court in finding that the company possesses this right. Reaffirming a former decision of its own, relied on by the lower court, the Supreme Court said: "This is a legitimate mode of extending the company's business, in direct furtherance of its charter object."

▼

Pros and Cons of Public Ownership

XENIA, Ohio, through its City Commission, has approved a plan for purchasing the distributing system of the Dayton Power & Light Company. The Dayton utility maintains a substation in Xenia and supplies light and power to all industries and homes in the city and to many surrounding towns. Its franchise expires the latter part of this year.

At a special election recently Pierre, S. D., voted 483 to 230 for a bond issue of $125,000 to build a new municipal light plant. Approximately 68 per cent of the votes favored the bond issue, 60 per cent being necessary to authorize it. Twice in the past year the electors have voted more than two to one against the sale of the present city plant.

The town of Herman, Neb., has sold its municipally owned plant to the Nebraska Power Company, by direction of the voters. The City Council of Blair rejected an offer from the company to pay $275,000 for its plant.

Paragould, Ark., will on September 21 vote on setting up a municipal light and power plant. It is now served by the Arkansas Utilities Company.

The Waynesboro (Va.) City Council has called a special election for August 12 to decide on the proposed sale of the city-owned power plant to the Virginia Public Service Company for $300,000. The company already sells energy there.

An election has been called by the Forest City (N. C.) Aldermen for September 16 to decide whether Forest City shall sell its water and light plants to the Southern Public Utilities Company. For the electric system this company offers $315,000.

By a margin of five votes the municipally owned power plant and distribution system of Paonia, Colo., has been sold to the Oliver Power Company for

$40,000, following a hotly contested election.

An offer of $2,000,000 has been made by a Vancouver representative of English interests to the city of Nelson, British Columbia, for the municipal power plant and distribution system. The program under the proposed agreement would include construction of two transmission lines from the power plant to Nelson.

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Tidal Power's Effect on Fisheries to Be Studied

JOINT investigation by the United States and Canada on the probable effects on fisheries of the proposed development to generate electric power from the movements of the tides in Passamaquoddy and Cobscook Bays will be initiated as soon as Canada is ready to proceed with the work, according to the United States Bureau of Fisheries. A joint resolution of Congress authorizing an appropriation of $45,000 to defray one-half of the expenses of the investigation was approved by the President on June 9, 1930. Subsequently $22,500 was appropriated for the current fiscal year.

This action was taken as a result of a note from the Canadian government of September 20, 1929, proposing such a joint investigation, requiring at least two years of field observations.

▼

Commercial Men Gather at Green Bay, Wis.

DELEGATES to the number of 180 attended the annual two-day convention of the Commercial Section of the Wisconsin Utilities Association, which was held at Green Bay, July 31 and August 1. Featured talks on the program were made by M. H. Frank, president of the association; Grant Call, Edison General Electric Appliance Company, who spoke on "The Load on Main Street"; Homer J. Buckley of Buckley, Dement & Company, Chicago, on the use of direct-mail advertising by utilities; I. L. Illing, Milwaukee Electric Railway & Light Company, "A National Awakening in Lighting Interest—What Is the Reason?" and L. L. Scott, Wisconsin Public Service Corporation, "Employees' Sales Education."

E. L. Brunsman, Jr., Madison, was elected chairman of the section. He is southern division commercial manager of the Wisconsin Power & Light Company. R. O. Jasperson, commercial manager of the Milwaukee Gas Light Company, was elected vice-chairman.

"OLD SPANISH DAYS" AT SANTA BARBARA

—Jessie T. Beals

El Paseo, Santa Barbara, provides the setting for much of the festivity that characterizes that California city every year in connection with the "Old Spanish Days Fiesta." The night scenes have a fascination which artistic lighting enhances. This year's celebration is taking place on August 7, 8 and 9.

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Diverting a River by a Precast Cofferdam

SOMETHING new in hydraulic engineering preparatory to the construction of the Alcoa Power Company's hydro-electric plant at Chute-à-Caron, on the Saguenay River in Quebec, was accomplished at that site on July 23. A diversion channel which ultimately will serve as an intake channel and tailrace had been dug parallel to the river, but the customary means of diverting the flow were found insufficient because of its velocity.

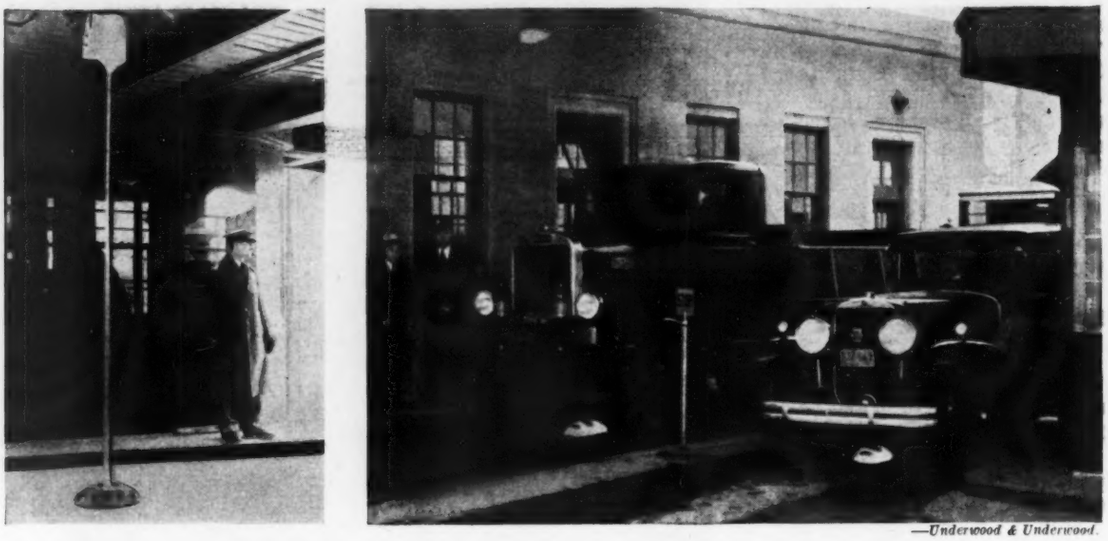
Acting on the proposal of James W. Rickey, hydraulic engineer of the Aluminum Company of America, a dam was built out from both sides of the river, leaving the deep gorge open, and into this there was tipped a precast concrete cofferdam, 92 ft. long by 45 ft. wide, which had been built in a vertical position on an island in the river and balanced on two piers. This dam contained 5,400 cu.yd. of concrete and weighed 11,000 tons. The face toward the channel was contoured to fit the river bottom, and when the supporting pier on the side toward the channel was blasted away the precast dam rolled over the cylindrical part of the remaining pier and fell into place in 30 ft. of swiftly moving water, coming to rest within an inch of the calculated position without any fracture.

▼

Photo-Electric Cell Operates from the Air

TURNED on by the operation of a photo-electric cell actuated by the Mayor of Charlottesville, Va., on the occasion of the dedication of the Virginia Public Service Company's handsome new office building in that city, the mammoth Jefferson searchlamp, on top of the Monticello Hotel, a mile away, itself actuated a second photo-electric cell suspended from a captive balloon over the new utility structure, and this in turn automatically lighted the entire building. According to a Westinghouse engineer, this was the first time that the photo-electric cell had been used off the ground.

"ELECTRIC EYES" CONTROL AND COUNT CARS CROSSING BRIDGE



—Underwood & Underwood

Again the "electric eye"! This one, devised by Benjamin Cooper, is in use on Ambassador Bridge, the new international link joining Detroit to Windsor, Ontario, where, as automobiles pause in front of the toll house, a vertical beam of light passing from a light source to a photo-electric cell imbedded in the pavement is intercepted, causing a series of relays to be operated, which in turn operate the counter register and extinguish the indicator lamp on the control board in the supervisor's office

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St. Louis Company Puts Out Duct Fire Quickly

ON THE morning of July 24 the Union Electric Light & Power Company encountered the most serious fire ever experienced in its underground wire system in St. Louis. The fire broke out at 10 a.m. 8 ft. underground in the ducts leading from the company's largest direct-current substation at Tenth and St. Charles Streets. Its origin has not been determined, the heat in the ducts having been of such intensity as actually to fuse the copper cables, the lead covering, the ducts themselves and even the surrounding earth in such a manner as to destroy all evidence of the cause. The gases generated by the heat quickly spread the fire throughout the ducts, and within a few minutes flames were leaping 20 ft. in the air from the manholes, covers of which had been blown off. Sixty cables were directly involved, and as a result of the extensive direct-current network which serves downtown St. Louis, short-circuit conditions were widespread.

Within a few minutes 200 employees had been assembled and the fight against the fire was begun. Fifty tons of sand were dumped into the manholes, many large tanks of liquid carbon dioxide were liberated, and as a last resort more than a ton of dry ice at a temperature of 114 deg. below zero was fed to the flames. The fire was under control at 1 p.m., and reconstruction was under way.

Owing to the prompt and efficient manner in which the Union Electric organization met the emergency service was not interrupted except to three customers, though the voltage in the territory surrounding the fire was low. Within two hours service to all but the three customers was normal, following the laying of lead-covered cables in gutters and other emergency repairs; by 6 p.m. normal service was restored to all but two customers, and those two were clear at midnight.

▼

Another Hydro Plant for Kootenay River

STILL another major hydro-electric development is to be undertaken in the southern interior of British Columbia by the West Kootenay Power & Light Company, according to preliminary plans submitted to the government. The company proposes to erect its third big plant on the Kootenay River, 2 miles above Upper Bonnington, to develop at least 30,000 hp. Already it has a large development at South Slocan, one at Lower Bonnington and one at Upper Bonnington, with a total output of 162,000 hp. At the same time the company is developing 30,000 hp. on the Adams River east of Kamloops. The new scheme will not affect the company's plans to develop the Pend Oreille River near the United States boundary.

▼

Post-Graduate Courses for Stevens Institute

THE curriculum of Stevens Institute of Technology for the academic year 1930-1931 will, for the first time in its 60-year history, include courses for graduate students. Stevens has heretofore offered a general unspecialized course in engineering and has given only the undergraduate degree in course. Since the inauguration of President Harvey N. Davis a faculty committee has been investigating the field of graduate instruction. Following the recommendation of this committee, the trustees and faculty have approved a program of graduate courses leading to the degree of master of science.

Graduate instruction is given during the day in the fields of electrical, mechanical, chemical and civil engineering and in business administration. Research projects in the properties of steam, smoke abatement and the measurement of engineering aptitudes are now in progress. A bulletin on graduate courses is available.

First County-Owned Plant Goes Into Operation

TEN THOUSAND people from all sections of Georgia witnessed on August 1 the formal opening of the Crisp County power plant at Cordele, believed to be the only plant in the United States owned by a county. Governor L. G. Hardman, Senator Walter F. George, Congressman C. R. Crisp and W. H. Doris, president of the Crisp County Board of Trade, made addresses in the morning; a barbecue was held for all, and at 2:30 p.m. a "motorcade" went out to the site of the plant for the actual dedication ceremonies.

Formal opening of the plant follows seven years of activity, including special governmental and state action permitting the construction of the plant, the passage of a bond issue and the overcoming of many engineering difficulties. The plant, rated at 9,600 hp., with an ultimate capacity of 18,200 hp., cost $1,250,000. It will not only supply Cordele with power, but contracts have been made with nearby cities.

As noted before in these columns, a distinctive feature is the use of two types of waterwheel runner, the Francis and the Propeller, so that the plant may possess extremely high efficiency at normal head and high power when floods cause low head. For loads from 1,400 hp. up the efficiency is to be at least 87.29 per cent; the average efficiency from 4,500 hp. to 10,000 hp. is to be 90 per cent.

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Coming Meetings

Association of Electragists International—Hotel Schroeder, Milwaukee, Aug. 18-20. L. W. Davis, 420 Lexington Ave., New York.

Institute of Radio Engineers—King Edward Hotel, Toronto, Aug. 18-21. H. P. Westman, 33 West 39th St., New York.

International Association of Electrical Inspectors—Northwest Section, Bellingham, Wash., Aug. 25-27. F. D. Weber, 414 Lumbermen's Bldg., Portland, Ore. Western Section, Congress Hotel, Chicago, Sept. 15-18. W. S. Boyd, 175 Jackson Blvd., Chicago. Eastern Section, Pittsfield, Mass., Sept. 22-24. R. Walker, 85 John St., New York.

American Institute of Electrical Engineers — Pacific Coast convention, Portland, Ore., Sept. 2-5; Middle Eastern district, Philadelphia, Oct. 13-15. F. L. Hutchinson, 33 West 39th St., New York.

Pennsylvania Electric Association—Bedford Springs, Pa., Sept. 3-5. Harold A. Buch, Telegraph Bldg., Harrisburg, Pa.

Empire State Gas and Electric Association—Saranac Inn, N. Y., Sept. 18 and 19; Meter Section, Watertown, N. Y., Oct. 9 and 10. C. H. B. Chapin, Grand Central Terminal, New York.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Sept. 25-27. T. C. Polk, 20 North Wacker Drive, Chicago.

American Electrochemical Society — Hotel Statler, Detroit, Sept. 25-27. C. G. Fink, Columbia University, New York.

National Safety Council—Pittsburgh, Sept. 29-Oct. 4. W. H. Cameron, 20 North Wacker Drive, Chicago.

New England Division, N.E.L.A.—New Ocean House, Swampscott, Mass., Sept. 29-Oct. 1. Miss O. A. Bursiel, 20 Providence St., Boston.

Illuminating Engineering Society — Hotel John Marshall, Richmond, Va., Oct. 7-10. E. H. Hobbie, 29 West 39th St., New York.

Rocky Mountain Division, N.E.L.A.—Franciscan Hotel, Albuquerque, N. M., Oct. 20-22. O. H. Weller, Public Service Co. of Colorado, Denver.

National Electrical Manufacturers' Association — Chamberlain-Vanderbilt Hotel, Old Point Comfort, Va., Oct. 20-24. A. W. Berresford, 420 Lexington Ave., New York.

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Oregon Regulators Like Steam-Plant Reliability

CONSTERNATION is said to have developed in the ranks of Oregon advocates of public ownership of hydro-electric utilities as a result of an official declaration of the Public Service Commission that the reliability of steam power for the generation of electricity offsets any advantage in production costs which may be obtainable by the use of water power. In view of the fact that the commission's opinion is based upon the reports of investigations made by the department's expert engineering staff, the Oregon Municipal Utilities Ownership League is finding it difficult to sustain its past statements that hydro-electric power is the best and cheapest power.

That the league and other advocates of public ownership were making progress with their campaign to encourage state-wide municipal ownership of utilities was thought to be attested by the attitude of the candidates for the various state offices and the reaction of the electorate in favor of gubernatorial aspirants whose platforms contain public ownership planks. Advocacy of hydro-electric development gained the considerable following of those who desire public ownership in Oregon largely because no candidate for office would assert opinions to the contrary. The commission, however, has incidentally supplied figures now being used by those opposed to public ownership in refutation of ill-advised informative material being distributed by the water-power enthusiasts of the state.

Advices received by the commission indicate that it has become necessary for hydro-electric operators to place their steam standby equipment in operation because of low water. Reports in the office of the state engineer show that water shortage throughout the whole state is gradually becoming acute.

DOWN WITH THE STACK!

After maintaining steam equipment for four years for emergencies that never arose after the Keystone Public Service Company of Franklin, Pa., contracted to supply electrical energy to the local waterworks, city officials recently demolished the 125-ft. brick smokestack erected in 1919.

▼

New Oregon Nominee for Governor Not Radical

WITHIN two months of the death of George W. Joseph, whom the Republican electorate of Oregon nominated for Governor on a platform recommending public ownership of electric utilities, the State Republican Central Committee, composed of an elective representative from every county, convened and named in succession to Mr. Joseph a candidate who is diametrically opposed to the principles which were laid down by the late nominee and accepted by the voters at the primary election last May.

Phil Metschan of Portland is the committee's choice for Governor, and in his platform there is no reference made to public ownership of utilities. Mr. Metschan does recommend, however, that the transportation, power and irrigation potentialities of the Columbia River be developed by the federal government. He also sets forth in his platform that he is "firmly opposed to the abolishment of the Public Service Commission," contending that such a movement "would be welcomed by the powerful corporations, which are better controlled by regulatory commissions, federal and state, than by any other method yet devised."

Great Britain's Projected Interconnections Now Approved
(See page 250)
NORTH SEA
IRISH SEA
ENGLISH CHANNEL
Kannock
Dundee
Greenock
EDINBURGH
Berwick
GLASGOW
Kilmarnock
Amble
Carlisle
Sunderland
Darlington
Scarborough
Lancaster
Harrogate
York
Leeds
Hull
Preston
Southport
LIVERPOOL
Wakefield
Grimsby
Sheffield
Chesterfield
Lincoln
Crewe
Derby
Nottingham
Stafford
Ironbridge
Birmingham
Liecester
Peterborough
Yarmouth
Norwich
Northampton
Warwick
Bedford
Ipswich
Colchester
Hereford
Worcester
Llanelly
Newport
Oxford
LONDON
Bristol
Reading
Cardiff
Croydon
Tunbridge Wells
Folkestone
Salisbury
Taunton
Southampton
Hastings
Brighton
Portsmouth
Exeter
Weymouth
Devonport
London Area
Hornsey
Walthamstow
Islington
Hackney
Barking
Willesden
Bankside
Woolwich
Battersea
Barnes
Wimbledon
Kingston
LEGEND
Principal transmission lines
Secondary " "
Generating stations (selected)
Generating stations (temporary arrangements)
Principal transforming stations
Secondary " and-or switching stations
LEGEND
Primary stations
Secondary stations
132-Kilovolt transformer stations
Hydro-electric stations
Main transmission lines

EDITORIALS

L.W.W.MORROW
Editor

A Test of State Regulation

IN RESPONSE to the direct suggestion of Milo R. Maltbie, chairman of the New York State Public Service Commission, that lower rates in New York City might be in order, Matthew S. Sloan, president of four of New York City's five electric light and power companies, promptly offered the city a rate reduction of approximately $5,000,000. This is on the basis of cutting the flat rate of 7 cents, now in effect, to 5 cents and introducing a monthly fixed charge of 60 cents per meter. Mr. Sloan has computed that it costs more than $1.50 a month to supply service to present non-profitable small customers, but is willing to accept 60 cents as a compromise.

The proposed rate system would constitute a test of the service charge in a large city. On the basis of the figures presented on pages 257 and 258 of this issue, in tables released by Mr. Sloan, it is evident that no reductions are involved for domestic customers who use less than 30 kilowatt-hours per month, these representing, under the proposed schedules, all those paying less than $2.10 per month. This means, from the same figures, that 996,870, or 60 per cent, of the 1,669,419 residential customers of the metropolitan companies will be paying increased amounts instead of realizing upon the proposed reduction. These are, of course, the small users who have in fact never paid their way and who have ridden parasitically upon the profitable customers of the companies.

Now is the time to place the state administration and the New York Public Service Commission on a high plane of long-range vision for public service. Now is the time to aid the world's largest municipality to sense the economic virtue in the customer charge, which aims first to eliminate the loss incurred in serving the small user and, second, to open up to all users the opportunity to derive the fuller benefits of electricity at decreasing rates. Now is the time to insure to its citizens the accomplishment of a saving of more than $5,000,000 a year in outlay for electric service and, better yet, the laying of a foundation that will eliminate the excrescence of submetering and pave the way for a completed promotional rate structure.

In 1929 only 2,500,000 domestic customers in cities of more than 20,000 population were buying electricity on the obsolete straight-line meter rate such as New York City still has. The commission and the utility executives are to be commended for undertaking a very difficult and complicated rate study and for approaching the problem by placing definite proposals for modern rate forms on the table for discussion. If the utility officials and the commission are left alone by the demagogue and the politician, there is little doubt that these reasonable and informed men will arrive at an agreement that will be fair to the public and to the utility.

Will Climatic Changes Affect Water Power?

REPEATED deficiencies in water power on the Pacific Coast, and to some extent elsewhere in the United States, have led to increased reliance upon steam, and presumably to a corresponding cautiousness in making further huge investments in hydro-electric projects.

Now comes another factor. Analysis of rainfall records over a fifty-two year period for a certain region in the Pacific Northwest reveals a very definite downward trend. Computed on the assumption of a straight line, it makes the normal for 1929 only 69 per cent of that at the beginning of the period.

No one but a climatologist can say what the

prospects are for the future. Certainly no one else would wish to hazard even a posthumous reputation by predicting absolute aridity in the year 2040 on the basis of rainfall between 1878 and 1929. That climate varies is well known. On the West Coast evidence of periods of greater or less rainfall during the past two thousand years, or longer, has been found by examination of the annual rings of "big trees" that have been felled.

The remote future need not concern us. But what may happen during the probable life of present-day engineering structures is a matter of engineering and economic significance. It is clear that a plant built on the assumption of an average rainfall of 34 inches may not justify its cost on a 27.5-inch rainfall—one, moreover, that seems to be decreasing. And the reverse is equally true, with a rising rainfall; a project rejected as being unadvisable on the half-century's 34-inch average might well be undertaken if the real average had risen to 40 inches and were still climbing.

While a single example proves nothing, the subject appears to be one that would warrant further study.

France's Special Need for Labor-Saving Devices

SIXTEEN years ago France was plunged, with her neighbors, into world war. One almost immediate result was a drastic decline in the birth rate. That part of the existing generation that would now have been in its early "'teens" remained largely unborn. The economic consequences of this inhibition have only now—in 1930—become seriously apparent. Today French factories are seeking in vain for the fifteen-year-old apprentices who would this year have begun to shoulder their industrial burden.

But modern industry has a substitute—labor-saving devices. For the tragic reasons stated France becomes one of the most fertile markets for American electrical and mechanical substitutes for human labor. In order to maintain her industrial independence France has placed severe restrictions upon the importation of certain classes of goods from the United States, but these in general do not include electrical appliances and equipment, which we shipped to the value of $3,028,509 to French importers last year.

There is ample evidence that manufacturers of electrical equipment should find it profitable to investigate the possibilities of filling the gap of France's industrial class of 1930, and other European countries may offer equally good business prospects.

Industrial High-Frequency Current Supply

APPLICATIONS of high-frequency tools are finding wider and wider favor in industry, but if complete satisfaction is to be obtained, the voltage regulation of the high-frequency power supply must be more closely analyzed, otherwise the motors may overheat, stall or burn out.

When the induction-converter form of supply is used, employing a wound-rotor induction motor driven backward at twice its synchronous speed, the regulation of the 60-cycle circuit is carried over into the high-frequency output. Thus, if the regulation of the 60-cycle circuit is 10 per cent and that of the machine itself is 8 per cent, there will be a total possible voltage reduction under extreme operating conditions of 17.2 per cent. Since the torque of an induction motor varies as the square of the applied voltage, it is apparent that the torque on the tool may be reduced to 68 per cent of its normal value.

Against this operating deficiency of the induction-converter under extreme supply and load conditions is to be balanced the lower cost of the machine in comparison with the other means for high-frequency generation—that is, the motor-generator set. It is, of course, possible that on large installations the inherently poor regulation characteristics of the converter may be removed, or at least improved, by the use of regulating means, such as an automatic induction regulator equipped with a contact-making voltmeter or some other voltage-boosting device. Recourse to this expedient, however, would probably bring the cost of the converter up to and perhaps over the cost of the motor-generator. In the case of the latter the 60-cycle circuit regulation does not persist through the machine, and also the common

methods of automatic field control permit the high-frequency voltage to be regulated at a comparatively low cost.

Consequently, when the installation of a group of high-frequency tools is contemplated serious consideration should be given to the possible growth of the load, so that there may be no later reason for the discarding of supply equipment originally purchased in favor of a machine or machines of greater capacity and better regulation characteristics.

Why Measure Tropical Miles with an Arctic Yardstick?

MORE load per domestic customer may mean a better load factor, but it may also mean a wider range of load variation per meter. The watt-hour meter of 1920-25 was as good as load conditions of that period demanded, but it is not good enough for many of today's loads. An old 5-ampere meter 3 per cent slow on 10-ampere load entails a 2 per cent loss in total revenue if 10-ampere, 5-ampere and 1-ampere loads each represent a third of the day. The 1926-1930 meter brings the revenue to its proper level, merely retrieving a discount which the customer has not earned. The new line of watt-hour meters has as good accuracy on loads of 300 to 400 per cent as the former design had at 125 to 150 per cent of its rating.

Hand in hand with the improvement in overload characteristics of meters has gone improved performance on varying voltage, varying frequency and varying temperature. With the steady improvement in the regulation of frequency and voltage the improved meter characteristics in these directions are of decreasing significance, but all incidental gains are welcomed in a device which commands so much respect for its general accuracy. But independence of temperature variations is a distinctly desirable feature with meters, residential or industrial, that are outdoors or elsewhere subjected to extreme variations of temperature. This is especially true of the two-element polyphase meter, one element of which always functions at a lower power factor than that of the polyphase load. Temperature compensation in the modern meter has greatly reduced the departures in accuracy at all temperatures and power factors.

The modernized meter deserves a fair survey of its economic potentialities and by this route a chance to prove its case against its less versatile predecessor. In many instances the recovery of lost revenue will retire the difference in investment in short order and pay clear dividends for the rest of the new meter's life. And no one should overlook the fact that test meters have kept one stride ahead of the service meter. Meter test records show some queer seasonal drifts when uncompensated portable test meters are continued in use to test the compensated service meters that have filtered into the system during the last three or four years.

Fuller compensation of watt-hour meters represents the one great stride since "lagging" gave them a well-rounded accuracy on power loads. The utility and industrial users of watt-hour meters should give the latest characteristics an economic hearing.

Lengthening the Perspective

THE remarkable improvement in the use of fuel that has occurred since 1919 is well known. In that year the Geological Survey began collecting monthly statistics of energy production and fuel consumption. These statistics become more valuable the longer their collection is continued. They show that during the ten-year period the average output per pound of fuel in all public utility plants in the United States nearly doubled. The consumption was 3.2 pounds per kilowatt-hour in 1919, 1.67 pounds in 1929.

But what happened before 1919? The industry was then more than 35 years old. It had made prodigious strides, not merely in magnitude but in engineering, in organization, in finance. In the eighties the power plant was in the middle of its service area; coal had to be hauled by wagon through the streets; the exhaust steam from the reciprocating engines was blown off into the air. Two decades later the turbine was just coming in, but the non-condensing reciprocating engine still dominated the field. The question is repeatedly asked, What was the average fuel efficiency in the earlier years; for instance, at least back to the beginning of the present century?

Great Britain Electrifies

National plan for a wholesale electric power supply completed since 1926. Seven geographical regions have a co-ordinated plan for generation and transmission. Popularity based upon recognition of electricity as influential in economic and social progress

By L. W. W. MORROW

Editor ELECTRICAL WORLD

AT THE end of the World War leaders of Great Britain recognized that the economic and social progress of the country depended upon the effective use of all national resources in labor, raw materials and power. As a first step the light and power industry was studied in an endeavor to make available ample and economical electric power for industry and for the home. As a result, since 1926, an agency called the Electricity Commission, aided by another agency called the Central Electricity Board, has established a national electrical power supply. This is based upon dividing the country into eight or nine major regions or zones and establishing in each zone generating plants and transmission lines to wholesale electric power to existing distributing agencies and to co-ordinate each region with the others.

The accepted regional plans embrace 94 per cent of the area of England and Wales and 98 per cent of the population. With the completion of the minor plans remaining and the complete installation of facilities allocated to each region, Great Britain will have a national electricity supply that promises to be a most effective tool in industrial rehabilitation and progress and in raising the standards of living. The plan has been very popular with the public and its results are awaited with great expectations. In fact, there is too great enthusiasm and exaggeration in the thought that the new power supply will solve all the industrial, social and economic ills of the country.

The entire scheme was made possible by educational and publicity effort. The announced objectives were to accelerate industrial modernization programs, to make electricity more widely available for industrial, domestic, commercial and agricultural use, to raise the social and industrial standards by means that have been found effective in other countries and to conserve fuel. As a result of the educational and publicity efforts the necessary legislation was enacted and the scheme became the most popular and most-discussed national movement of recent years.

Many people fail to recognize that the national power supply of itself cannot be effective unless industry is sufficiently active and prosperous to use it, nor can social standards be raised and home conveniences be increased unless the public has adequate purchasing power. The electricity generated must be sold, the modernization of industry requires capital and markets for increased production facilities, the labor of the country must have work and adequate wages in order to buy electric service and electric appliances. Organized efforts to meet these conditions do not exist at present in Great Britain, and the great problem is to bring about the effective use of the power that has been made available. Despite present handicaps, however, the fact remains that a permanent national asset has been established by the intelligent and courageous efforts of those responsible for the British "grid" schemes. It will aid and accelerate the economic rehabilitation of the country.

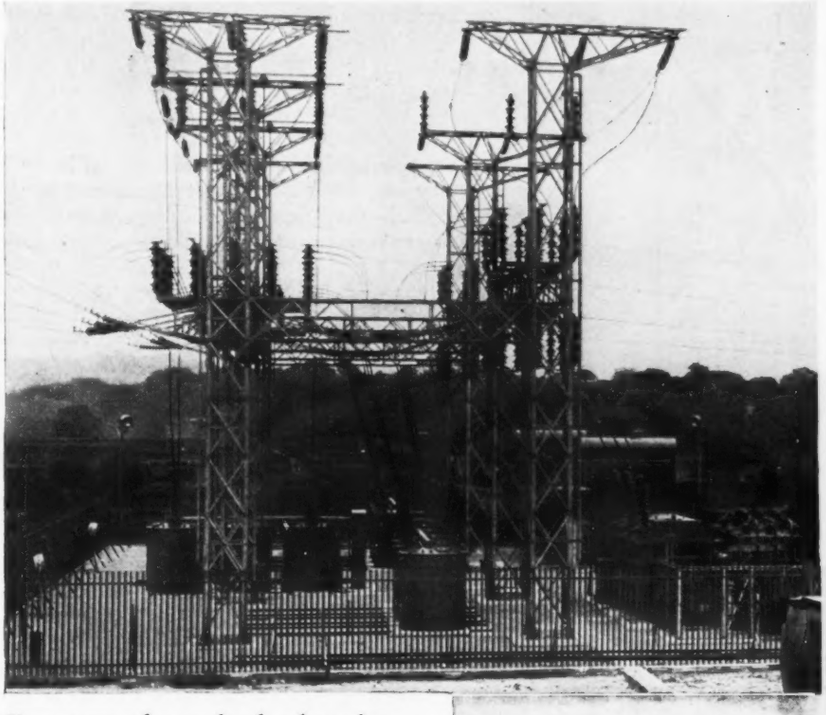
Radical changes in viewpoint

Previous to 1920 the light and power industry had been a creature of tradition, with no national entity, hedged about with stifling laws, faced with ill-conceived competition between units and unaided by any aggressive sales force. Technical progress had been made in power production and distribution equal to that in any country, and largely through technical improvements the cost of electricity decreased. The average price for electricity used for domestic purpose changed from 11 cents per kilowatt-hour in 1921 to 7 cents in 1927, with corresponding reductions in other classes of service.

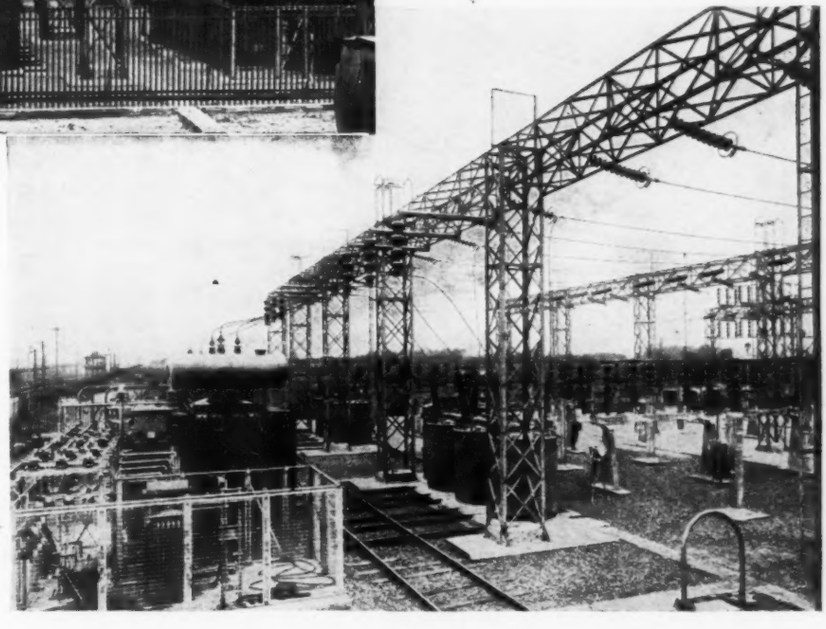
Table I—Utility Electrical Conditions in Great Britain—1928

Total number of companies	565
Local authorities	320
Electricity companies	225
Power companies	20
Generating stations, number	491
Local authorities	277
Companies	214
Capital investment, total	$1,085,191,530
Local authorities	$696,038,270
Companies	$389,163,260
Average price per kw.-hr., cents	3.68
Gross revenue	$214,805,490
Installed capacity, kw.	4,421,602
Maximum load, kw.	2,557,956
Spare capacity, per cent maximum load	73
Total kw.-hr. sales	5,606,100,000
Sales per capita, kw.-hr.	128
Annual load factor, per cent	25
Coal used per kw.-hr., lb.	2.87
Investment per kw. installed capacity	$245.50

But as an industry and as a business there was no coherence. Each unit had grown up in its local territory and developed its facilities independently of other units, even with respect to distribution voltage and frequency. Many legislative restrictions existed that could be changed only with difficulty. Authority over utilities headed up in the Board of Trade, the Minister of Transport and the Minister of Health, with local authorities in the form of cities, county boroughs, municipal boroughs, urban districts, rural district councils and parish councils. Some of these authorities were in the light and power business, independent light and power companies existed, many private industrial plants were in the light and power business as a side line and many municipal operations existed. These utilities were scattered independent operations, each with its traditions, practices, legislative powers and group of customers. The distribution situation is chaotic, to put it mildly. Sample distribution voltages are 100, 105, 110, 200 and 250. Sample frequencies are 25, 40, 50, 60, 83 and 100.



One type of standard substation for the British grid



British grid standard type substation for a city supply

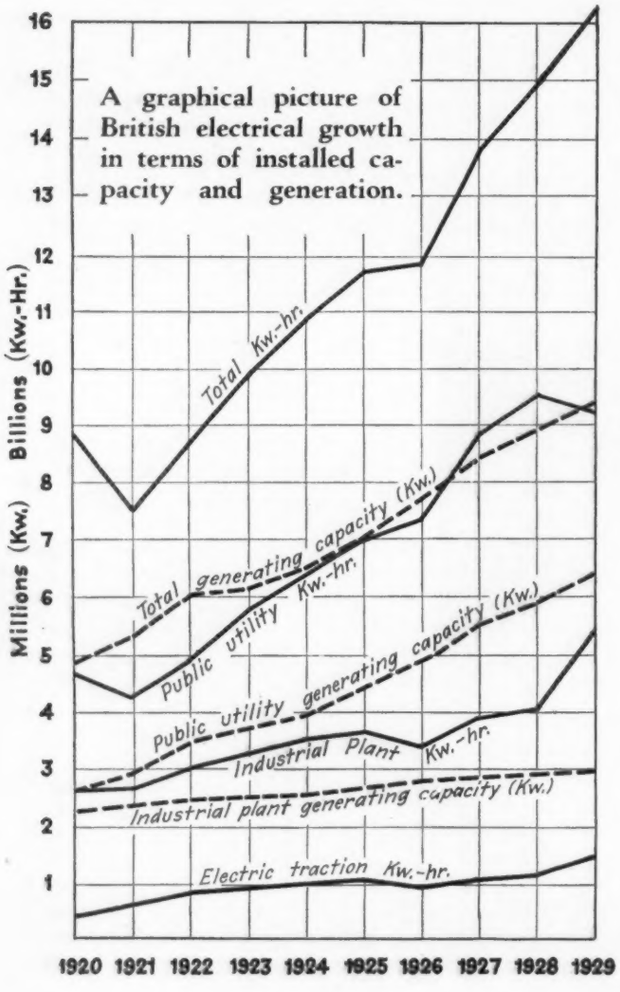
Municipalities and local authorities produce about 65 per cent of the energy sold, and in the past two years the largest increase has been in the growth in the amount of energy sold by private industrial plants. There were 659 individual distributing companies in Great Britain in 1929. Authorized utilities produced 9,473,000,000 kw.-hr. in 1929 and street railway, railroad and non-statutory utilities produced 10,879,000,000 kw.-hr. The increase was 9.5 per cent over 1928. The per capita use in 1929 was 171 kw.-hr.

The initial move was made to get some order into the situation by enacting legislation to form an Electricity Commission in 1919. This commission was formed to divide the country into power areas, to regulate and to supervise the supply of electricity through the organization of "joint authorities" in each region. It had no compulsory powers and no power to act. It did good work in studying the situation, collecting data and developing publicity about the needs of the industry and managed to set up four joint authorities by agreement. This work culminated in a report of the Weir committee in 1925, which recommended legislation that was enacted by Parliament in 1926. This legislation created a Central Electricity Board that was to carry out the plans developed by the Electricity Commission. The board was given power:

1. To carry out the schemes provided by the Electricity Commissioners covering:
   (a) Selection of generating stations.
   (b) Construction of transmission lines and transformer stations.
   (c) Standardization of frequency.

2. To fix the loads and operating hours of selected stations.
3. To purchase energy at cost price from generating stations.
4. To arrange for new stations and extension of existing stations.
5. To supply electrical energy in bulk to all distributing companies in Great Britain.
6. To fix rates so that its income over a period of years would balance expenditures.

The legislation gave power to the Electricity Commissioners to pay the Central Board for expenses incurred in standardizing frequency and the treasury can guarantee any loans raised by the board up to an aggregate of $167,500,000. The board has the power to pay interest from capital during preliminary stages and to suspend sinking funds for not more than five years.



Thus the national supply was devised by superimposing a superstructure on the existing chaotic light and power structure. This will permit of the development of plans for gradually getting some order and standardization in local distribution and yet make quickly available an adequate power supply in all regions at an economical price.

Basis of sale for power

The Central Electricity Board is, in effect, a national utility formed on a joint-stock principle with representation of the main interests and subject in details to the Minister of Transport. It will sell power to local companies and buy power from them at prices based on production costs. This board believes that by 1940 about 100 selected stations will furnish the national electricity supply instead of the 564 at present existing. It has divided Great Britain into seven main power zones or areas, standardized the frequency at 50 cycles and has planned the regional power developments up to 1941. The main zones are: Central Scotland, northwest England, northeast England, mideast England, central England, southeast England, southwest England, with smaller areas in southern and northern Scotland. Each power region or "grid" will be equipped with medium-sized generating stations (100,000 to 300,000 kw.), with the station generating units averaging about 40,000 kw. in capacity.

The Central Electricity Board must be able to produce electricity in each district at an average price lower than that prevailing if it expects to sell its product to distributing companies.

The intention is to fix a uniform average for each district and sample 1934 prices expected are about as follows: Central Scotland, 0.8 cent; southeast England, 1.1 cents; central England, 0.728 cent; northwest England, 0.756 cent; mideast England, 0.779 cent; or the national average price as retailed to distributing companies will lie between 0.7 and 0.8 cent per unit. The national price of generation in 1926-27 was 1.34 cents, including fixed charges. It is thought industries will obtain power at from 1 cent to 1.2 cents per kilowatt-hour.

Typical regional scheme

A typical regional program of the Central Electricity Board is found in the details of the seventh and last regional plan announced for southwest England and south Wales, an area of 17,234 square miles. The area at the last census had a population of 6,085,000 and embraces densely populated industrial centers, including colliery districts, important seaports, china-clay and tin mining.

The cost to the Central Electricity Board of erecting the transmission system is estimated at $17,000,000. In addition there will be expended by existing electrical companies nearly $10,000,000 for extensions. It is estimated that the full advantage of the scheme can be secured with a saving of $7,000,000 in capital expenditures up to 1936. After that date the savings will be progressively greater. According to the plan, from 1932 to 1937 there will be a saving to existing companies in the area of about $7,000,000, or an average of about $1,400,000 per year that should be reflected in a reduction in price to consumers.

At present there are 165 utilities in the area owning 107 generating stations. Under the regional plan six selected stations will be operated by the Central Electricity Board and two new stations will be erected, one near Southampton and one in South Wales. During the transition period eleven more stations will be operated for a few years and a few outlying stations will operate until it is possible for them to be replaced by purchased energy. Two of the selected stations, one at Bristol and one in South Wales, will supply the base load.

The main transmission system will consist of 623 route-miles of line and 25 transformer stations. The secondary transmission will involve an additional eleven

transformer stations. It is anticipated that the entire grid system will be completed in the autumn of 1933. The interconnection of stations will release for revenue-earning purposes a capital value of about $15,300,000 now required by reserve generating capacity. In this area the per capita use of electricity in 1927-28 was 77 kw.-hr. and by 1935-36 it is estimated the use will increase to 205 kw.-hr. per capita. This typical grid scheme is only one of seven that has been approved and some of them are in practically complete operation.

Up to December 31, 1929, the Electricity Commissioners had approved borrowing by the board of $72,500,000 for building lines, etc., and $27,000,000 for standardizing frequency. In May, 1929, the board made an issue of $15,000,000 4 per cent stock and in January, 1930, another issue of $35,000,000 of 5 per cent stock.

The capital involved in the entire scheme is superimposed upon existing capital to give electric service, and it is only good business to sell energy rapidly and promote load growth in order to get the earning period on the new capital advanced. In a sense, the entire investment in the grid is based on economies to be realized in the future. It will take some years, however, to evaluate the entire national saving brought about by the Central Electricity Board activities. The total value of contracts placed by the Central Electricity Board up to December 31, 1929, was $54,495,000, with payments certified for $6,419,000.

The loudest objection to the national electrification comes from the landed squires, who dislike seeing the very beautiful English countryside marred by gaunt steel structures. They are upheld by the farmers, who have an antipathy for anything that might, even in a remote way, conflict with their ancestral freedom from interference. Surprisingly, the chorus is joined by some people in the aviation industry who fear the hazards of high-tension wires.

Technical features of the grid

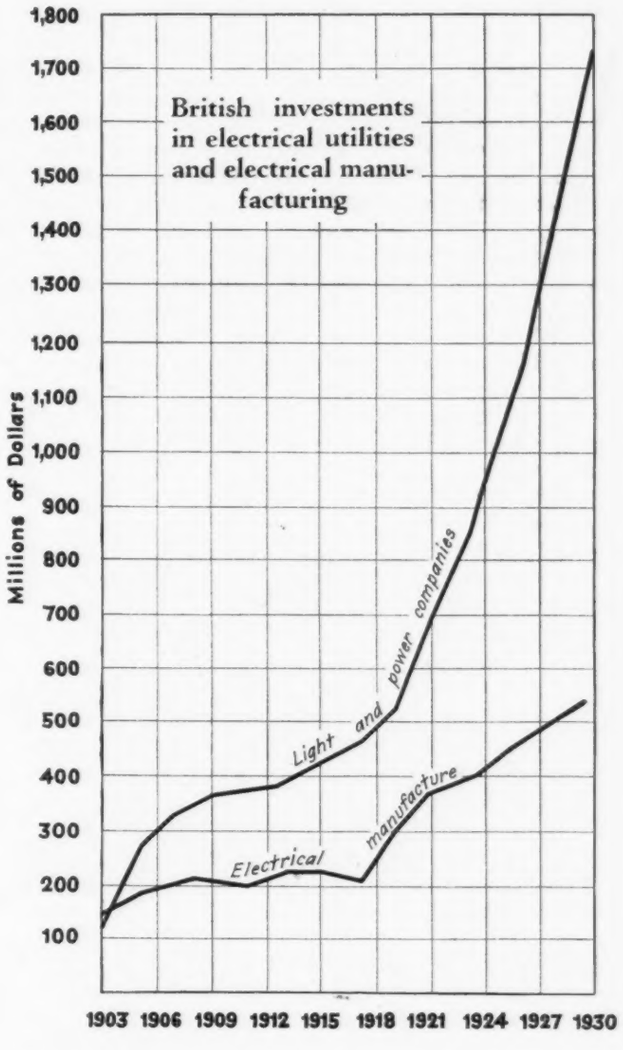
The interconnected transmission system will consist of 132-kv. lines, three phase, 50 cycles, with all transformers solidly grounded on the high-tension side.

The standard line conductor consists of a central core steel strand of seven wires each 0.11 in. in diameter and 30 aluminum strands each 0.11 in. in diameter, giving an over-all conductor diameter of 0.77 in., with a maximum working tension of 8,000 lb. and an ultimate strength of 17,772 lb. The earth conductor is also steel core aluminum wire with an over-all diameter of 0.55 in. The standard capacity of a single-circuit line is 50,000 kw., with normal critical corona voltage of 184 kv.

Several standard wide base steel towers have been chosen for use and the normal span length is 900 ft. The clearance to ground of the lowest line conductor is 22 ft. at 50 deg. C. The vertical distance between conductors is 12 ft. and the projected horizontal distance 3 ft. Minimum normal clearance between live parts and towers is 3 ft. 6 in. under the worst conditions of line displacement. Foundations are excavated earth, concrete ball and ordinary concrete, the type used being fixed by local conditions.

The vertical loading of towers was assumed as weight of all conductors and fittings with ½ in. of ice and the transverse loading is figured on the basis of 8 lb. per square foot wind pressure on the projected area, the horizontal resultant of conductor tensions and a wind pressure of 25 lb. per square foot on the projected area of the members of one face of the towers. The factor of safety is 2.5 with unbroken conductors and 1.5 with broken conductors and maximum loadings.

The maximum working load on the insulators is 4,000 lb., breaking load 6,000 lb., number of units nine with 5-in. centers; the dry flashover of a unit is 85 kv., the wet flashover is 60 kv and the minimum puncture voltage is 145 kv. Forged steel and malleable iron fittings are used on the ball-and-socket type insulators and mild steel guard rings and arcing horns are used. Pilot wire protection is used on short lines and cables and impedance relays on the longer lines.



Six standard types of substations are used, with 9-ft. minimum spacing of conductors and 4-ft. 6-in. clearance to live parts. Single-turn bushing type current transformers are used and potential transformers are connected to the low-voltage side of the main transformers.

Of the 491 generating stations in 1928, 39 had more than 50 per cent of the total installed capacity and 205 of the stations had less than 2 per cent of the installed capacity. It is proposed to use economical stations at high load factor on a three-shift basis, the second grade

stations will operate as two-shift stations on the remainder of the load and the least efficient station will operate one shift on the winter peaks.

All 132,000-volt substations will be of the outdoor type and 1,500,000-kw. rupturing capacity oil breakers have been adopted as standard for both 132,000-volt and 66,000-volt systems. The standard kilovolt-ampere transformer capacities are 7,500, 10,000, 15,000, 20,000, 30,000, 45,000, 60,000 and 75,000. Whenever possible three-phase transformer units are used and all transformers are air-cooled, with neutrals grounded. Lightning arresters are not used on the systems.

Market possibilities

Industry takes 64 per cent of the electricity sold by light and power companies, although industrial electrification is only about 51 per cent, as compared to 78 per cent in the United States and 66 per cent in Germany. A market exists for 1,200,000 electrical horsepower in coal mining, 974,000 hp. in iron and steel and 640,000 hp. in textiles, with chemicals, ship building and grain milling as other potential markets. It is estimated that the electrical output of Great Britain would require to be increased 78 per cent to come up to the present averages in the United States. In the past seven years the per cent of electricity used for power has declined 10 per cent, lighting and domestic has increased 50 per cent and electric traction has decreased 10 per cent. The present proportions are approximately 65 per cent for power, 25 per cent for lighting and domestic and 10 per cent for traction.

The big problem is to sell the power that will be produced by the grids of the Central Electricity Board. In order of magnitude the power market is in industry, transportation, commerce and shipping, agriculture and domestic services. Industry is the largest market, but it is in poor shape to buy or use electric power. Firms in good economic condition will modernize and use electric power if the price of the power warrants the economic changes; these firms are not numerous. A second group of firms has low financial resources and cannot raise money to buy modern equipment to utilize electric power, and a third group in the basic industries finds itself hard put to earn even fixed charges and has no reserves for obsolescence and depreciation. These firms are applying self-preservation policies and non-expansion programs. Since 1921 generally, industry has been under a constant deflation and credit restriction with additional taxation and little or no increase in production; it is in no condition to modernize or to buy electric power.

An industrial rationalization and integration policy

*Table II—Balance Sheet Comparisons and Estimates for Great Britain**

Year	1926	1940
Kw.-hr. per capita	128	500
Maximum load, kw.	2,557,956	8,135,000
Installed capacity, kw.	4,421,602	10,000,000
Spare plant, per cent	73	25
Total kw.-hr. sales	5,606,100,000	21,385,000,000
Load factor, per cent	25	30
Capital investment		
Generation	$496,240,000	635,000,000
Distribution	608,950,000	$1,217,500,000
Grid transmission	.....	145,000,000
Total	$1,005,190,000	$1,997,500,000
Total revenue	$214,805,000	$440,000,000
Average price per kw.-hr., cents	3.68	2 or less
Number of stations	491	124

*Sir Archibald Page, the Institution of Civil Engineers, 1929.

Table III—Estimate of Expenditures for Great Britain for Electrification 1929-1941

Central Electricity Board	$1,800,000,000
Extensions of selected generating stations	3,070,000,000
Extensions of private industrial plants	975,000,000
Distribution plant and equipment	5,360,000,000
Consumers' apparatus	9,500,000,000
Telegraph, wireless and other branches	7,300,000,000
Supply material and wiring supplies	7,300,000,000
Contract, erection installation work	3,640,000,000
Total	$39,945,000,000
Annual average	3,900,000,000

Table IV—Growth of Generating Capacity in Great Britain

	(Kw. Millions)		
Industry	1907	1912	1924
Light and power	1.002	1.454	3.943
Mines and quarries	0.111	0.372	0.839
Iron and steel	0.246	0.340	0.663
Textiles	0.077	0.165	0.273
Others	0.268	0.370	0.789
Total	1.704	2.701	6.507

Table V—Electricity Supply in Great Britain

	Capacity of Plants (Kw.)			Output of Electricity (Millions)			
					Private		
Year	Public	Private	Total	Public	Rail-ways	Industrial Plants	Total
1920	2,626,000	2,282,000	4,908,000	4,734	433	3,667	8,834
1921	2,986,000	2,374,000	5,360,000	4,214	671	2,669	7,554
1922	3,551,000	2,496,000	6,047,000	4,883	856	3,060	8,799
1923	3,678,000	2,507,000	6,185,000	5,775	907	3,280	9,952
1924	3,943,000	2,564,000	6,507,000	6,454	961	3,520	10,935
1925	4,415,000	2,675,000	7,090,000	7,094	1,029	3,630	11,753
1926	4,883,000	2,802,000	7,685,000	7,384	982	3,400	11,766
1927	5,535,000	2,865,000	8,400,000	8,829	1,099	3,900	13,828
1928	5,881,000	2,979,000	8,860,000	9,750	1,160	4,050	14,960
1929	.....	.....	.....	9,473	1,405	5,422	16,300

Total number of separate utilities was 659 at end of March, 1929.

Table VI—Changes in Electrical Manufacturing Costs in Great Britain

(Per Cent of Total Sales Price)

	1913	1927	Per Cent Increase in Cost of Production
Materials	48.3	42.5	155
Labor	26.3	28.5	216
Factory and commercial expenses	23.9	24.3	172
Taxation	1.5	4.7	630
Total	100.0	100.0	182

Table VII—Comparisons of Wages Paid in Electrical Manufacturing

	Cents per Hour		British Index—100	
Country	1913	1928	1913	1928
Great Britain	13.0	29.2	100	100
Germany	14.2	22.58	109	77
France	13.2	17.4	102	59
Belgium	....	13.0	...	44
Switzerland	11.6	20.0	89	72

must be put into operation first. Productive capacity must be brought into harmony with demand, the number of individual units in each industry must be reduced or affiliated, capitalization must be revalued to correspond to earning capacity, and many establishments must be abandoned.

Through co-operation or amalgamation national production must be controlled, prices stabilized and competition rationalized.

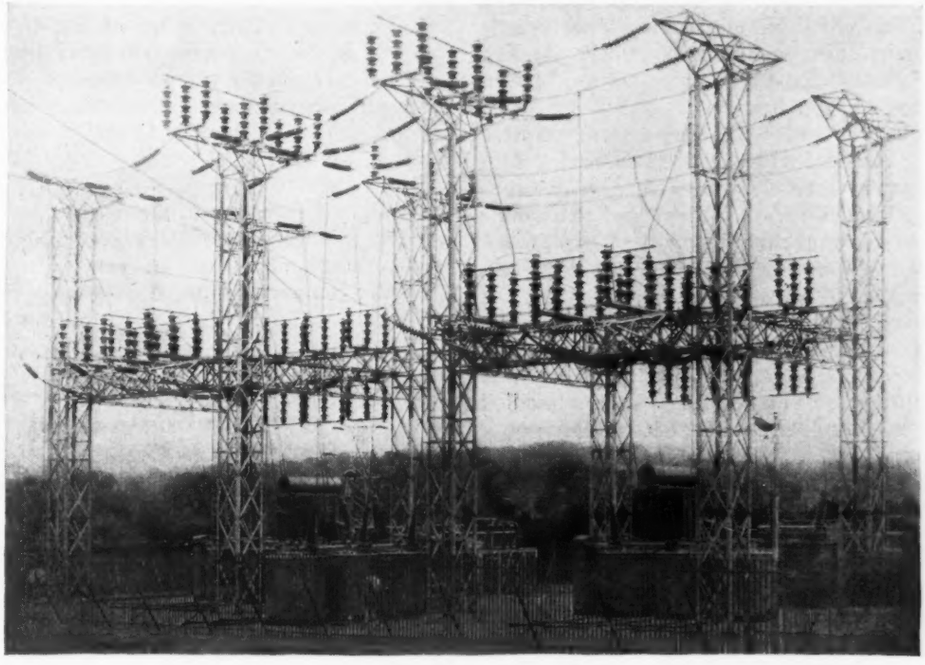
When this is done industry can modernize and can buy power, and some indications point to this process being carried out in some measure in iron and steel and in mining, but there is much to be done before the industrial market for electric power can be sold. It has been suggested that the government guarantee the capital for new equipment needed by industry in order to expedite the process, and other suggestions embody the renting of equipment by small industries.

In transportation—land and marine—there is a large electrical market. Great Britain, aside from the Southern Railway System, has done little to electrify its transportation facilities, and it is hoped the Electricity Board schemes will start this movement, because ample power will be available at about a cent per kilowatt-hour in every locality. Here again, however, the economic condition of the railways is not encouraging to the expenditure of new capital and some means must be had to make electrification economically feasible under the conditions that now prevail.

There are 263,000 farms of more than 50 acres in extent in Great Britain and experimental data show these to give a potential market of about 900,000,000 kw.-hr., and this, combined with rural villages and cottages, gives about 2,000,000,000 kw.-hr. as the annual agricultural and rural load. Power of any kind is little used on British farms at present and electrification of farms is a hobby and not a practice. Education and much time will be required to sell this load.

The domestic load is of great importance in Great Britain and can be amplified very greatly, with an ultimate estimate of 8,500,000,000 kw.-hr. per year, as compared to the present 1,400,000,000 kw.-hr. On the basis of American standards, even, the domestic business would aggregate 3,400,000,000 kw.-hr. and much activity is being devoted to building up this load. To the domestic business may be added better street lighting, illumination of public buildings, decorative lighting, signs and other uses of electricity that have been developed very little in Great Britain.

Thus the potential market for electricity in Great Britain is large, but each class of business must be improved in economic status before it can afford to use power and the electrical industry must gear itself to remedy this condition and to sell power before it can expect to advance. The Central Board can build the stations and lines, but this equipment will, of itself, not sell electric power.



Another type of standard British Grid substation

It is thus seen that the 1926 electricity supply act is accomplishing results. It is bringing about a co-ordinated electrical industry and is building the facilities needed to produce electric power. But two conditions exist that go beyond the physical accomplishments. One is the piquant situation whereby the national grid is fed and used by such diverse units as private light and power companies, private industrial plants and socialized or municipal light and power companies. At which end of the monster "lies the tail and who will wag the tail," is the apt way the question has been put by John A. Crabtree.

Another fact is that the national grid scheme will emphasize the importance of commercial activities. It

will be necessary to incorporate sales into utility management programs as never before, and sales in Great Britain are tied into the economic and social conditions of the country so intimately that utility managements must co-operate with all agencies seeking to cure social and economic ills if they are to sell their services.

A heretofore disorganized industry fitted with competitive units must learn how to co-operate and how to sell. These features, rather than the technical and physical features, introduce the problems that will make or mar the sound conception that underlies the splendid work of the Central Electricity Board.

▼ ▼ ▼

Man-Hour Units Useful Index in Rural Line Building

By ELLSWORTH F. MINER
U. S. Engineering Corporation, New York City

TO FACILITATE more accurate estimating of the costs of rural line construction time studies were made last summer and fall on two extensions built in eastern New England to supply single-phase, 2,300-volt service to farms and small village users. The records cover the jobs from start to finish, obviously yielding greater reliability than "stop-watch cross-section" methods frequently used in such studies.

For both lines only the poles, attachments and primary conductors (two 2,300-volt wires) are considered. Both lines are light, serving sparsely settled territories occupied by homes and small farms. This work was done by strong, capable laborers and linemen. No slackers, high-pressure methods or prize urge were involved, simply good utilization of personnel.

A Chevrolet 1-ton truck fitted with a Mead-Morrison capstan winch and a tubular frame derrick set all the poles that could be reached (about 80 per cent) and was used also to pull up wire. The 35-ft. poles were handled more easily and rapidly than was expected and not a single tip-over occurred.

Line A was begun May 16 and finished August 10, 1929. The crew varied from three to eleven. It was headed by a working foreman who laid out the operations, kept time and led the crew. Three experienced climbers were included and the others were occupied with digging and heavy work. This line is 60,550 ft. long. It follows a good highway, half the pole locations being in heavy underbrush, but comparatively little tree trimming was required.

Line B was begun November 14 and finished December 23, 1929. The crew varied from three to nine and encountered hard digging. Dynamite was required for 36 out of 84 holes and frozen ground delayed backfilling and tamping. This line followed a good highway. The first 22 poles (35-ft.) were joint construction with the telephone company. Heavy tree trimming (average pole spacing 130 ft.) and rather slow running out wire were necessary. Fifty spans of 220-ft. average spacing followed in the clear with one party line and then came twelve sections in the village at the end of the line. These short and long span sections are designated "S" and "L" in the table. This line has 11,000 ft. of 220-ft. span and 4,130 ft. of short span.

Truck drivers' time is included in the table. From the center of each line to the stockroom was 7.5 miles.

With this background the operating units expressed as man-hours per 1,000 ft. may be applied with confidence to comparable jobs and the proper multipliers used for variations from these specifications.

Pole Line Specifications

Poles:
(A) Fourteen 35-ft.; 55 30-ft.; 426 27-ft.; all 6-in. tops; about class C, white cedar, half seasoned.
(B) Fifteen 35-ft.; 65 30-ft.; four 25-ft., 7-in. tops; about class B, white cedar, pretty well seasoned.

Crossarms:
(A) Two-pin, 3-ft. unpainted fir, two braces.
(B) Two-pin, 5-ft. unpainted fir, two braces.

Guys:
(A) thirty-seven wire to ground, 84 wire to tree, 39 push.
(B) Six wire to ground, six wire to tree.
Wire guys, ⅜ strand; four three-wire clamps; one strain insulator, rod and slug in earth.

Conductors:
(A) No. 6, H. D. bare copper, soft copper ties, joints three-wire splice.
(B) No. 6 A.C.R.S. bare, armor tape wrapping every insulator, special tie No. 6 soft aluminum, joints made with oval sleeves in special wrenches.

Man-Hours per 1,000 Ft. of Rural Line Construction

	Line A	Line B	
		S	L
	123-Ft. Span	130-Ft. Span	220-Ft. Span
Layout Line			
Along state road, underbrush half of right-of-way	1.93	.....	.....
Along village street	.....	1.90	.....
Through open country	.....	.....	1.29
Dig pole holes	15.9	16.6	12.4
Set poles	15.0	18.0	14.1
Crossarms—two-pin			
Pinned, nailed, two braces, no paint each		0.160	
Set on poles	1.49	1.14	0.95
Conductors			
Run out, splice, pull up, put on insulators, tie in, trim 2-wire line, 2,300 volt	11.3	22.2	16.5
Guys			
Make up and put on			
Line (A)			
39 push, 37 strain to ground, 84 strain to tree.			
3.10 pole sections per guy, 2.65 guys per 1,000 ft., 2.81 hours per guy (average)			
6.7 hours per 1,000 ft. (average).			
Line (B)			
Six strain to ground, six strain to tree, 7.25 pole sections per guy, 0.8 guys per 1,000 ft. (average), 4.5 hours per guy (average), 3.6 hours per 1,000 ft. (average).			

Use of Auto Truck	Truck-Days per 1,000 Ft. ½-Ton, Box Body	Nine-Hour Days 1-Ton, Crane and Winch
Stake out line, cut right-of-way	0.1	0
Dig holes and set poles	0.5	0.45
Guys, make up, put on	0.1	0
Crossarms, deliver	0.05	0.1
Crossarms, put on poles	0.11	0
Conductor, haul, run out, pull up, tie-in, trim, two wires	0.31	0.3

New York City Offered Lower Rates

Reduction from 7 to 5 cents contingent upon ratification of the principle of monthly fixed charge, set at 60 cents per meter

REDUCTIONS in electric rates during the last two years in New York City have amounted to more than $6,000,000, and these are now further augmented by schedules filed on August 1 which will pass on to the consumers in the metropolis another $5,000,000. If the proposals are accepted by the Public Service Commission, as is expected to be the case, three significant results are accomplished:

1. Litigation dating from Mayor Hylan's régime, and some much older, will be terminated.
2. The rates will be uniform all over New York City.
3. The principle of the fixed charge, so widely acknowledged and applied elsewhere, will receive further authoritative confirmation.

Ever since Matthew S. Sloan became president of all four of the Edison companies, New York Edison, United Electric Light & Power, Brooklyn Edison and New York & Queens Electric Light & Power, the officials and experts have been at work analyzing the use habits of and monthly revenue from all classes of residential and commercial customers. Various possible rates have been canvassed, ranging from a residential rate of $1 per month plus 4½ cents per kilowatt-hour (coupled with a demand charge of $1.50 per kilowatt for commercial customers) to a $0.60 fixed charge and a 5-cent energy rate (coupled with $1 per month per kilowatt for commercial loads). The former would come much nearer to an equal distribution of costs for small and large users, both residential and commercial, as shown by the study of customer-cost. It was felt, however, that the larger fixed charge coupled with an immediately lower energy rate would act to postpone the day when a block rate would safely be employed to offer real inducement to increased derivation of the benefits of elec-

OPERATING EXPENSE AND RETURN PROPERLY COVERED BY A FIXED CHARGE

Yearly customer cost including costs of the service connection and the meter on the customers' premises and the direct cost of reading the meter, the preparation and collection of the bill and the customers' accounting in the offices of the company, but *exclusive* of a number of other items of customers' operating and investment costs which, while they should be included in the items coverable by a fixed charge, however, have been omitted because they are not specifically assignable in whole.

Classification Number Under Uniform System of Accounts		Total Cost per Annum	Cost per Meter per Annum Based on 2,000,133 Average Number of Meters
	Operating Expenses Incurred for Service to Customers		
731.51	Salaries and expenses in meter department engaged in service to customers	$436,546.76	$0.22
731.52	Testing and inspecting meters on customers' premises or in shop	677,090.14	0.34
731.53	Miscellaneous expenses of meter department, tools and supplies, stationery, light, fuel, etc.	92,562.90	0.04
731.54	Removing and resetting meters, connecting and disconnecting services	461,438.02	0.23
732.6	Maintenance of services leading from the mains to customers' premises	921,385.68	0.46
732.72	Maintenance of customers' meter—replacement of parts, cleaning and painting	290,770.04	0.15
751.21	Inspection of customers' premises for municipal and Underwriters' inspection certificates	285,598.98	0.14
751.22	Attention to customers' complaints, replacing or repairing wiring of appliances, without charge	1,174,142.88	0.59
760	Labor cost of meter readers, bookkeepers employed on customers' accounts, employees in the application bureau for service to consumer, preparation and collection of bills and general supplies and expenses applicable to the foregoing activities	10,489,341.04	5.24
780	General and miscellaneous expenses, office rentals, correspondence, mailing and filing, telephone service, transportation, and uncollectible bills	4,115,013.21	2.06
	Taxes, insurance and retirement expense related to customers' service installations and meters	2,996,436.63	1.50
	Total operating expense incurred directly for service to customers, at least	$21,940,326.28	$10.97
	Carrying Charges at 8 per Cent per Annum on Investments Made to Serve Customers		
335	Installed cost of conductors, insulators, ducts, supports, etc., connection with house wiring and meter protection devices	$3,138,502.47	$1.57
338	Cost of meters, current limiting devices, and appurtenances used in measuring the electric energy	1,786,866.02	0.89
339	Cost of the first setting of meters for determining the amount of electric energy	401,629.96	0.20
	Total carrying charges on investments made directly to serve customers, at least	$5,326,998.45	$2.66
	Total direct customer cost, at least	$27,267,324.73	$13.63

Details of Effect Upon Residential Rates (The Four System Companies)

60-cent fixed customer charge
5-cent kilowatt-hour energy charge

Data Calculated on Annual Basis as of April, 1930

Monthly Kw.-Hr. Blocks	Number of Customers	Annual Kw.-Hr.	Annual Present Revenue	Revenue from Above Rates	Resultant Change in Revenue*
0–10	199,933	15,648,156	$1,408,328	$2,221,925	$813,597
11–20	407,370	76,710,252	5,416,684	6,768,577	1,351,893
21–30	379,567	115,326,672	8,064,492	8,499,216	434,724
31–40	256,461	107,840,940	7,547,615	7,238,566	*309,049*
41–50	150,014	81,039,804	5,671,456	5,132,091	*539,365*
51–60	85,967	56,801,712	3,978,056	3,459,048	*519,008*
61–70	52,371	40,896,924	2,862,231	2,421,917	*440,314*
71–80	34,649	31,307,460	2,191,113	1,814,846	*376,267*
81–90	23,431	23,965,536	1,677,256	1,366,980	*310,276*
91–100	16,695	19,087,536	1,331,928	1,074,581	*257,347*
101–120	20,775	27,222,960	1,888,263	1,510,728	*377,535*
121–140	11,882	18,479,532	1,275,758	1,009,527	*266,231*
141–160	7,145	12,866,028	885,996	694,745	*191,251*
161–180	4,602	9,388,572	645,075	502,563	*142,512*
181–200	3,317	7,515,924	515,076	399,679	*115,397*
201–300	7,966	22,916,856	1,562,617	1,203,198	*359,419*
301–Over	7,274	45,104,292	3,041,899	2,307,588	*734,311*
Total	1,669,419	712,119,156	$49,963,843	$47,625,775	*$2,338,068* (Decrease)

* Decrease in revenues indicated by figures in italics.

Details of Effect Upon Commercial Rates (The Four System Companies)

Fixed customer charge—60 cents per meter per month.
Demand charge—$1 per kilowatt per month.
Energy charge—First 5,000 kw.-hr. per month at 5 cents per kilowatt-hour—Excess at 4 cents per kilowatt-hour.

Data Calculated on Annual Basis as of April, 1930

Monthly Kw.-Hr. Blocks	Number of Customers	Annual Kw.-Hr.	Annual Present Revenue	Revenue from Above Rates	Resultant Change in Revenue*
0–10	21,261	1,392,648	$182,203	$249,735	$67,532
11–20	25,681	4,771,848	340,057	488,860	148,803
21–30	22,706	6,888,516	482,347	602,277	119,930
31–40	19,542	8,344,320	583,829	672,242	88,413
41–50	16,865	9,206,328	644,540	707,864	63,324
51–60	14,354	9,543,132	668,446	711,257	42,811
61–70	12,340	9,711,960	680,093	707,478	27,385
71–80	10,562	9,568,416	670,562	685,531	14,969
81–90	9,062	9,278,772	649,872	656,277	6,385
91–100	7,922	9,083,184	634,433	635,626	1,193
101–120	13,108	17,340,792	1,205,147	1,151,533	*53,614*
121–140	10,318	16,245,132	1,124,446	1,064,554	*59,892*
141–160	8,437	15,262,248	1,050,924	991,103	*59,821*
161–180	6,993	14,335,560	984,315	924,220	*60,095*
181–200	6,034	13,741,860	938,873	881,102	*57,771*
201–300	20,745	61,087,788	4,113,925	3,761,633	*352,292*
301–400	11,923	49,565,256	3,300,859	2,903,600	*397,259*
401–500	7,741	42,258,816	2,798,439	2,458,104	*340,335*
501–600	5,206	34,240,980	2,260,877	1,984,060	*276,817*
601–700	3,532	27,441,924	1,811,401	1,585,495	*225,906*
701–800	2,608	23,323,032	1,530,157	1,344,685	*185,472*
801–900	1,921	19,576,728	1,286,481	1,126,756	*159,725*
901–1000	1,321	15,059,400	979,666	865,609	*114,057*
1001–2000	7,614	120,888,156	7,714,856	6,761,629	*953,227*
2001–3000	1,973	57,661,440	3,434,943	3,213,226	*221,717*
3001–4000	898	37,041,504	2,093,471	2,061,509	*31,962*
4001–5000	110	5,807,364	330,752	322,972	*7,780*
5001–6000	58	3,824,844	215,216	209,175	*6,041*
6001–7000	30	2,333,424	130,741	124,345	*6,396*
7001–8000	15	1,348,560	74,988	70,430	*4,558*
8001–9000	10	1,028,280	55,079	52,843	*2,236*
9001–10000	5	573,600	30,940	29,124	*1,816*
Excess	5	720,036	36,174	35,774	*400*
Total	270,900	658,495,848	$43,039,072	$40,040,628	*$2,998,444* (Decrease)

* Decrease in revenues indicated by figures in italics.

tricity by all classes of customers. The definite proposal made is, therefore:

Residential customers
Energy charge.....5 cents per kilowatt-hour
Fixed charge.....60 cents per month

Commercial customers
Energy charge..First 5,000 kw.-hr. at 5 cents per kilowatt-hour
Excess.....4 cents per kilowatt-hour
Fixed charge.....60 cents per month
Demand charge.....$1 per kilowatt per month

The Edison group, in support of the complete justification of the fixed charge, filed an analysis of the customer-cost experience. Only items directly chargeable to this element of cost were included, and even then the total is $13.63, or more than $1 per month, per customer meter. Mr. Sloan stated that this would be brought to at least $1.50 per month if certain other expenses were properly allocated in part to this item. He cited the experience with the very small-use customer in the following terms: "Thousands of our customers use no electricity at all during portions of the year and thousands of others use only a very small quantity in the course of a whole year. Under the existing flat rate they pay nothing at all for the valuable asset of having the service instantly available at all times. This cost must be borne by other customers, and it is the function of this new rate to shift the burden where it belongs. Those customers who will experience a slight increase in monthly bill are not primarily those of small income who live in flats and tenements; they are largely the owners of large homes and occupants of small apartments who are irregular and infrequent users of energy. In some instances our meter readers cannot get in to read the meter for months at a time, and when it is read the consumption, the bill and the revenue are nearly nil. The fixed charge we propose will not cover the full costs of supplying service to these non-profitable customers. We are not asking for full reimbursement of these expenses. We are making the fixed charge as little as we see how to do it and still get away from a system of rates detrimental both to customers and companies."

In further support of the fixed charge principle it is shown that the $5,500,000, more or less, which the companies are in a position to apply to reduction of rates would only make a change from the present 7-cent rate to 6.5 cents. The chairman of the commission, in his public statements, intimated that the commission looked for a reduction to 6 cents or even to 5 cents. The company has taken the stand that either of these flat reductions in a straight meter rate would reduce the revenue so that it would fall far short of returning fair earnings on either the present value or the investment value of the properties devoted to electric service. With the 60-cent fixed charge applied to both residential and commercial customers, a 5-cent rate will bring in 1931 revenue which is calculated to provide a return of 7.29 per cent on the investment cost of $833,562,017 and a return of 5.94 per cent on the present value of $1,022,136,721.

Mr. Sloan in his letter to the commission said:

"Any vertical reduction in the top retail rates would inflict an unwarranted and irretrievable loss, while some moderate diminution of earnings to facilitate a promotional rate would, we expect, be fully compensated and regained, in a few years, through the increased revenue from a more abundant use of low-priced energy by residential and commercial customers."

Careful Planning Pays in Airport Lighting

Care used in preliminary study and planning; centralized remote control and underground distribution are features of Denver's airport lighting

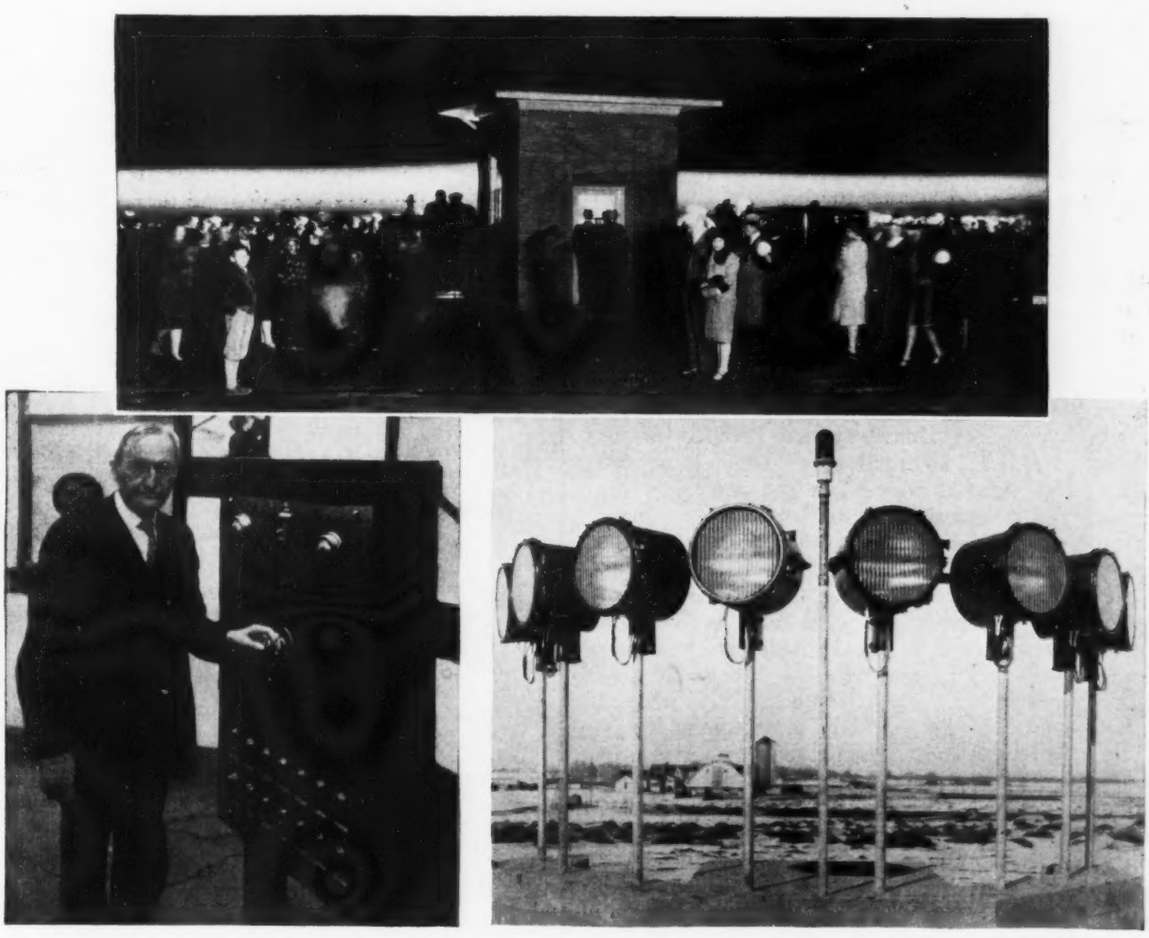
By F. S. PETERSON
Illuminating Engineer
Public Service Company of Colorado, Denver, Colo.

LIGHTING and electrical facilities of Denver's recently dedicated airport were provided for after a complete study and examination had been made of the leading airports in the country. As a result, Denver may be said to have an airport which combines the best ideas and practices of other installations. Cost of the electrical installation for lighting alone amounted to $31,500. The B.B.T. Corporation supplied the fixtures.

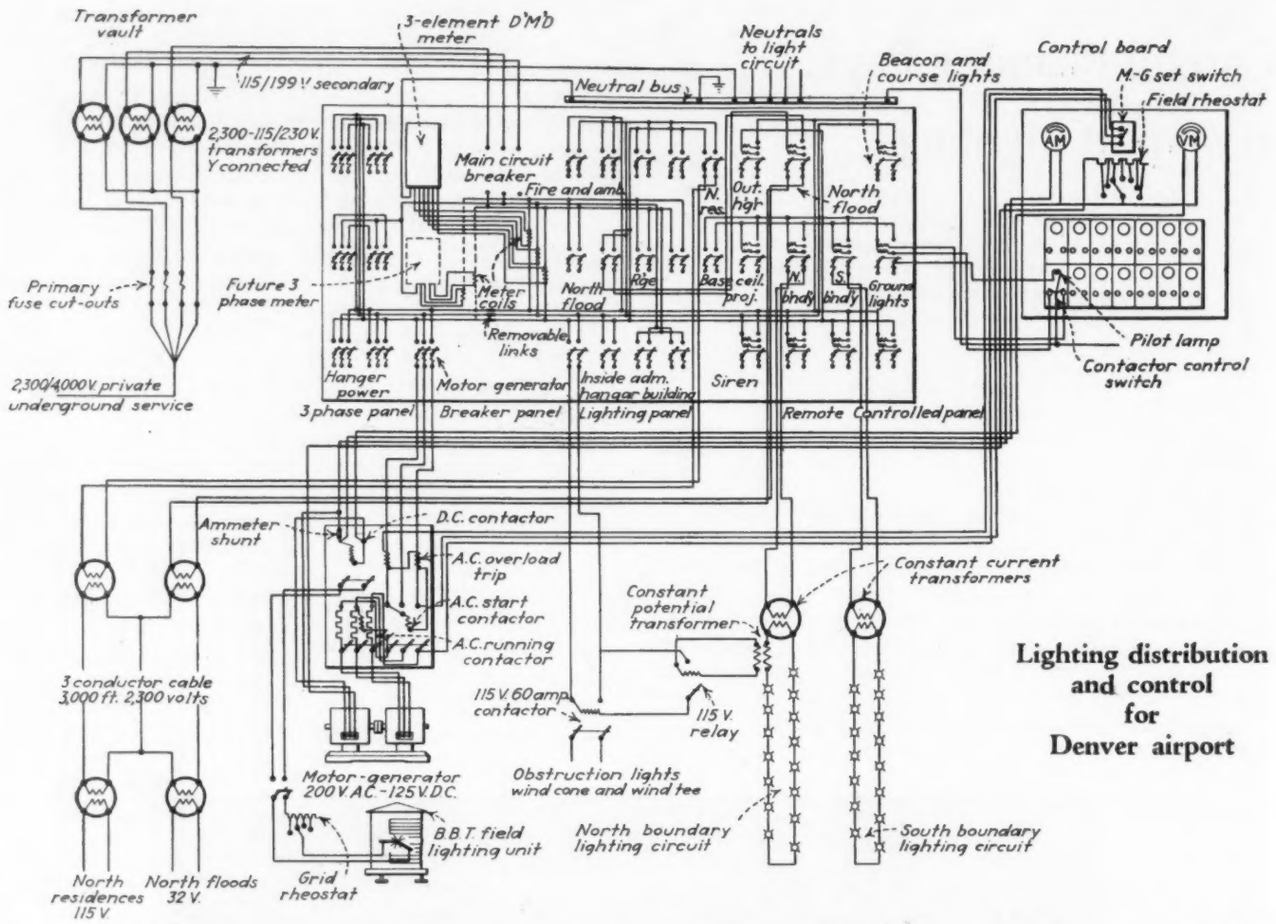
The airport is served by a 2,300/4,000-volt, three-phase, four-wire underground primary cable running from a terminal pole off the property to a vault located in the administration building. Three 50-kva. transformers step down to 115/199 volts, three-phase, four-wire service for power and lighting. The main switchboard is arranged for distribution in three groups, the three-phase power, the three-phase, four-wire lighting and the three-phase, four-wire remote control lighting. Every circuit on the airport, except the interior lighting in buildings, is remotely controlled from a board in a room overlooking the field on the second floor of the administration building.

This is an important feature of the installation and gives the dispatcher or chief of field operations control of all lighting at his fingertips. The circuits in operation are indicated by a red bullseye above the switch of each circuit. Voltmeter, ammeter and field rheostat for the motor-generator set supplying direct current for the B.B.T., 150-amp. field floodlight also are a part of the remote-control board. The electric indicating dials for the various meteorological instruments are located in the central control room as well.

Boundary lights around the field are spaced approximately 225 ft. apart and are operated on two 6.6-amp. series circuits so as to comply with government regulations not to exceed more than 310 volts normal operating voltage and 450 volts maximum open circuit voltage. Sixty 600-lumen and eight 1,000-lumen lamps are used



B.B.T. landing light, remote-control board and field floodlights, Denver Airport



Lighting distribution and control for Denver airport

in the boundary lighting. Single-conductor, No. 8 Parkway cable was used around the field, except for the return circuits, which were taken care of by using two-conductor No. 8 Parkway cable across the center of the field connecting with each circuit.

One of the most difficult design problems in the lighting of any airport is the landing field floodlighting system. The government requires a minimum vertical plane intensity of not less than 0.15 ft.-candles over the entire usable part of the landing area. A centralized system was adopted at Denver which resulted in the selection of a B.B.T. air mail type, 180-deg. spread floodlight. This light is located in the center of the west boundary in a separate building between the hangar and administration building. Since the prevailing winds are from the south, the B.B.T. unit will be used about 80 per cent of the time. However, for taking care of landings and takeoffs when the wind direction changes to the east or west there has been provided in the center of the north boundary a bank of eight 3,000-watt field floodlighting projectors. Each projector is equipped with a 3,000-watt, 32-volt lamp and has a spread of 50 deg. The results are most satisfactory with the projectors arranged so that the 50-deg. beam spread overlaps the beam spread of the next projector and a 180-deg. spread of illumination covers the field with good distribution. Service for these projectors is provided by a 25-kva., 2,300/32-volt transformer located in a vault to the rear of the projectors. This transformer is fed by stepping up 200 volts off the main switchboard to 2,300 volts for crossing the field, a distance of 3,500 ft.

Careful planning and capitalizing on experience gained elsewhere are said to have given Denver one of the best lighted airports in the country.

Reprints Available

A few copies of the following reprints from ELECTRICAL WORLD are available for gratuitous distribution:

Electrification of Industries (Charts), August 17, 1929; 86 Utilities Report on Electrical Refrigeration, April 6, 1929; Substation Practice of Representative Utilities in United States, September 8, 1928; Single-Phase Condenser Motor, March, 1928; Profit vs. Volume in Pricing, March 24, 1928; Electric Range, Refrigerator and Oil Burner as Load Builders for Central Stations, January 21, 1928; Trinidad Burns Lignite, April 14, 1928; Developed Water Power in United States, April 4, 1927; Statistics on Prime Movers, Generators and Motors in Manufacturing Plants, January 1, 1926; Reliability of Transmission Lines, May 8, 1926.

Copies are also on hand of supplements, as follows: Engineering Details of Transmission Lines in the United States, Operated at or Above 66,000 Volts, September 21, 1929; Operating Data on Systems Having an Output of 100,000,000 Kw.-Hr. or More During 1929, May 3, 1930; same for 1928, May 18, 1929; same for 1927, May 5, 1928. The price of these supplements is $1 a copy.

Requests for any of this material should be addressed to the Statistical Editor.

ACIDITY in Insulating Oils

By G. L. SUMNERS

Insulating Oil Engineer
Westinghouse Electric & Manufacturing Company

IDEAL OIL has minimum tendency to sludge and to become acid. Inter-relation of acidity, moisture and sludging difficult to determine. Oxygen the chief source of oil trouble. Tests and preventives

WHEN oil is placed in electrical apparatus chemical changes begin to take place immediately. The rapidity of change is dependent on the particular type of service to which it is subjected, such as in circuit breakers or in transformers, and on the severity of this service. This change, especially in the early stages, is recognized by the development of organic acids.

Organic acids should not be confused with inorganic acids, such as sulphuric acid, remote traces of which are possible, though highly improbable, from refining the oil.

A few years ago it was customary to attempt to classify the acidity and report the amount in per cent as oleic acid. This was partly due to the closeness of the molecular weights of the more stable acids, in the calculation of which there could be little error, in the small amounts found in insulating oil, and partly because little was known about the various acids developed.

In order to avoid confusion, it is now the custom to report the acidity as the number of milligrams of potassium hydroxide required to neutralize one gram of the oil, and this value is known as the neutralization number. While this covers the total acidity, there is little chance of error in referring to the neutralization number as the organic acidity. In such cases, where there is a suspicion of the presence of inorganic acids, they may be determined as such, and the amount deducted from the total acidity as indicated by the neutralization number. The remainder will represent the organic acids present. The generally recognized method of obtaining the neutralization number is as follows:

Weigh accurately 10 grams of the oil into a flask. Add 50 cc. of a mixture of equal proportions of distilled water and 95 per cent alcohol which has been neutralized with weak caustic soda, and heat to the boiling point. Agitate the flask thoroughly in order to dissolve the acid constituents as completely as possible. Titrate while hot with aqueous tenth normal alkali, free from carbonate, using phenolthalein as an indicator, agitating thoroughly after each addition of alkali. Express results in terms of milligrams of potassium hydroxide required to saturate the free acid in one gram of oil.

New oil should not require more than 0.03 mg. of KOH to neutralize 1 gram of oil.

High acidity favors sludge

Oil which has developed high acidity (say it requires 0.5 mg. KOH to 0.6 to neutralize one gram of oil) may be expected to sludge. If there is not actual visible evidence on the windings of the transformer, it should be watched carefully for the appearance of sludge. The reason that sludge may be expected is because the unsaturated hydrocarbons in the oil are gradually picking up and combining with oxygen, forming such oxidation products as peroxides, alcohols, keytones and acids, both of the volatile and stable types. These products, of which the peroxides and volatile acids are the most active, react with the materials in the transformer and form metallic soaps, which are largely soluble in the oil, giving a potential sludging condition. These compounds further mature under heat and the oil becomes so saturated that it can no longer hold them in solution, and they are precipitated as sludge. In addition, there is sedimentation direct from the hydrocarbons. This is known as true sludge. The sludge seems to act as an accelerator or catalyst to produce more sludge, probably due to the interference in heat transference through clogging of the ducts.

Remedies for acidity

A combination centrifuge and blotter press will remove the sludge, but will not prevent further sludging when the oil is put in service again, and is only very slightly beneficial in reducing the acidity. It is possible, of course, to neutralize these acids with alkali, but there is always the danger of incomplete removal of the alkali as well as the soluble soaps and salts formed by its addition to the oil. The acidity may be somewhat reduced by such reagents as Fuller's earth, acticated carbon or silica gel. If the acidity has not been allowed to develop to the point where sludge may be expected, it may be effectively reduced by treatment with a weak alkaline reagent, such as water glass, using a centrifuge operated as a separator to remove the water glass and acid products, in conjunction with adsorbent earth, and sub-

sequent filtration under prescribed conditions. In the use of any method for reduction of acidity, it is of vital importance that all the active ingredients foreign to the oil be removed.

The ordinary characteristics which are used to describe a known oil, such as specific gravity, flash point, fire point and pour test, change very little over a long period in service, provided the oil has not been mixed with other oil or foreign material. This holds true either before or after purification of the oil by the various methods sponsored by the manufacturers of oil-insulated apparatus. The chief properties which indicate change in the oil are neutralization number, RE number (or SE number) dielectric strength, color and, of course, visible evidence of oxidation products precipitated as sludge.

Usually a high neutralization number is accompanied by a high RE number, but not necessarily so. Examination of some oils in service has shown very high RE numbers with relatively low neutralization numbers, while in others these relations have been just about reversed. The RE number measures the ability of the oil to separate from moisture. A high RE value indicates the tendency of oil to cling to any moisture present and hold it in suspension. Moisture, in suspension, reduces the oil's natural insulating property adjacent to the electric field. Obviously, inability of the oil to hold small amounts of moisture in suspension is a very desirable property, in that precipitated moisture offers no great menace to the electrical equipment.

In some applications this is of vital importance, while in others it is almost negligible. For instance, in circuit breakers we have an example of the former, where finely divided carbon tends to hold moisture in suspension. "Inertaire" transformers, where care is taken to prevent oxidation and to remove moisture from the transformer's breath, will illustrate the latter. The neutralization number in either case remains comparatively low.

Acidity and dielectric strength unrelated

In the development of organic acidity in oil in normal transformer service, especially in the early stages, there seems to be no relation to either dielectric strength or insulation resistance, and in one sense the dielectric strength is almost independent of the neutralization number. It is not uncommon for oil, having an acid value of 0.7 mg. of KOH, to have a dielectric strength of 30 kv. or better when there is no moisture present. However, the oil sometimes reaches a stage, particularly when sludging, that while it permits restoration of the dielectric strength to a satisfactory value of 22 kv. or better, this value cannot be maintained no matter how often the oil is filtered. Examination of such oil usually indicates a mixture of oils, or the presence of material foreign to the oil. There are doubtless other factors that enter into this condition, but when the oil reaches this stage, it is economical to replace with new oil, after first thoroughly cleaning the sludge from the windings and ducts by spraying with dry benzine, followed by flushing with a quantity of new oil. This will avoid contamination of the replacement oil and give it the life expected.

There are two kinds of oil advocated for oil-insulated apparatus, one which may be designated as non-sludging, with a high tendency to form organic acidity, and one which has a greater tendency to sludge with less tendency to develop acidity. The ideal oil is one which has a minimum tendency to sludge and a minimum tendency to develop acidity under normal service conditions. These oils may be produced from the same crude by variations in treatment.

The water white oils, which are examples of the so-called non-sludging class, have the tendency to produce acids in service to a very high degree and are often referred to as over-refined oils. Incidentally, they do produce a yellowish deposit, which, though different from ordinary sludge, is still undoubtedly sludge, although the color of the oil when sludging is lighter than other sludged oils. When the acid curve starts upward, the acidity developed seems to act as an accelerator or catalyst to produce more acid and the increase in acidity is very rapid. While this type of oil is not generally accepted for transformer service in this country, it illustrates the fact that acidity may reach the point where it becomes a menace. It is therefore desirable to choose an oil which offers little tendency to produce organic acids, under normal operating conditions, and to inspect it periodically to see that the acid remains low.

Oxygen chief enemy of oil

While all of the reactions that take place in oil are not fully understood, manufacturers of electrical apparatus have long recognized the fact that oxygen is the chief enemy of transformer oil, especially in the presence of heat and moisture. Considerable study has been made, and is still being made, of its effect on the oil and indirectly on the materials entering into transformer production.

There are several methods of attacking this problem. Obviously if air and moisture are prevented from coming into contact with the oil, oxidation, with resultant acidity, and the production of sludge will not take place. The "Inertaire" transformer was designed to meet this condition and is a commercial success. Therefore, oil in service in "Inertaire" transformers does not require the periodic treatment demanded by the regular power plant oil purification schedule. The important point is that this equipment has gone a long way toward the conservation of insulating oil, by extending its life almost indefinitely without purification.

Transformer oil naturally contains a considerable amount of oxygen in solution. In the conservator or expansion type of transformer oxygen has access from the outside air and the oxygen content of the oil is not removed. This being the case, the conservator type of design reduces but does not remove the conditions that are conducive to sludging.

The neutralization number which measures the more stable organic acids apparently does not give the correct picture of acid development in oil. The effect of the volatile acids may not be detected until after they have disappeared. Therefore, with the present knowledge on organic acidity development and its relation to both the life of the oil and to the life of the apparatus in which it is used, it is difficult to set practical limits on allowable acidity in transformer oil. Well-insulated windings, such as used in American practice of the varnish-impregnated type, are less susceptible to the action of organic acids than those of the untreated type, as in European practice. Also, the oil in contact with varnished coils does not appear to develop organic acidity to the same extent as it does in contact with untreated

coils, nor does the oil sludge as readily or as much, under equivalent conditions, of time and temperature.

In some cases, the first appearance of sludge is made when the neutralization number is between 0.5 and 0.6 mg. KOH; in other cases, there is no evidence of sludge, while in still others the oil shows considerable sludge at this value.

The condition of oil may not be judged by acidity alone. Therefore, any limits arbitrarily set would need to be so rigid that the user would have to scrap oil that is giving, and would probably continue to give, satisfactory service for a long time. As a guide to the public utilities and industrial maintenance department it is usually safe to assume that oil requiring 0.2 or 0.3 mg. KOH to neutralize 1 gram is sufficiently low to indicate the oil to be in good condition. A value of 0.5 or 0.6 would suggest the need to watch for visible evidence of sludge. Oil having an acidity of 0.7 or above may usually be replaced, economically, with new oil.

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German Field Studies of Lightning

Dr. A. Matthias of Berlin summarizes results of mountain-top studies. Direct strokes considered far more important than induced strokes. Recommends grounding all towers and using condensers to protect terminal apparatus

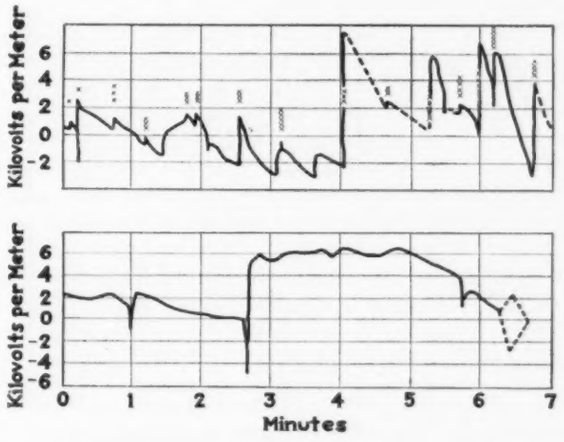
AN INTERESTING contribution to the problem of protecting electrical systems from lightning troubles is a paper by Prof. A. Matthias of Berlin in an issue of *Elektrotechnische Zeitschrift* which reports the research work done in 1925-1929 by the Association for the Study of Extra-High-Tension Systems in Germany. Studies of lightning phenomena and the behavior of protecting apparatus have been made in the field laboratory of the association and on a high mountain peak; the laboratory is underground and shielded.

The data collected show that in approximately 85 per cent of the cases of lightning discharges the electrons flow from cloud to earth and 15 per cent vice versa. The currents in the main flashes were found to be between 10,000 and 50,000 amp. and the quantity of electricity between 10 and 100 coulombs. Nearly every lightning stroke was found to be composed of a number of succeeding flashes. Forty-two partial discharges were observed in one bolt, with durations of 0.5 to 20 milliseconds and as much as 0.3 second between them. The total discharges had durations of up to one second. The discharges generally show a wide branching. Cases have been observed where one complete discharge covered an area of about 0.4 square mile. Partial discharges seemed to be aperiodic, only occasionally showing a damped oscillation of one cycle.

Changes of field strength versus time, as obtained under a storm cloud, are shown in the accompanying illustration. The curve shows that discharges can create changes in the field from negative to positive values. The voltage gradients underneath a storm cloud are comparatively small, but abrupt changes in the field are created by the lightning discharges. The observed values of the field strength on level ground were generally not higher than 12 kv. per foot, except in one case, where 30 kv. per foot was found. The changes of the field strength were comparatively slow, being in the general order of 100 microseconds, with occasional durations of 10 microseconds.

These facts led to the conclusion that induced surges cannot cause troubles on fairly well insulated systems.

The cause of lightning disturbances in lines is attributed entirely to direct strokes and their resultant traveling waves. It has been observed that lightning troubles are caused by waves of considerable steepness. Even the fastest changes in the field strength which have been observed in a region underneath a storm cloud are too slow to induce waves of a dangerous steepness. Moreover, these fast changes of 10 microseconds can only occur, according to the author, in the immediate neighborhood of the lightning front which affects only a small area. Since the amplitude of an induced wave is the smaller the smaller the region where the change in the field strength takes place, even the fastest changes cannot account for serious disturbances. The overvoltages induced by field changes too slow to cause traveling waves are not considered dangerous due to the depressing effect of the system capacitance upon the voltage and due to the drainage of the charge over the leakage resistance.



The voltage gradient averages slowly
Crosses indicate the number of partial discharges

Also, the usual explanation that chopped waves caused by flashovers on line insulators are the actual cause of line disturbance is not accepted.

The majority of lightning damages in stations are very distinct flashovers on terminals, which can be explained easily as caused by reflections of steep wave fronts but not by chopped waves. Where disturbances are experienced on lines not struck directly by lightning, it is considered that the troubles must have been due to partial discharges which were not observed.

Since a stroke generally brings a large amount of electricity into the line, it is considered highly important that the charge be carried to ground over the shortest possible path; i.e., over the nearest line insulator and tower or pole. Two requirements must be fulfilled. The insultors must have a low impulse lag, because this determines the voltage and duration of the first impact of the wave, and they must withstand the power arc safely. Insulators with well-projecting guard rings or chains with protecting baskets are recommended by Professor Matthias. To extinguish the power arc the usual ground coils (Petersen coils) are considered satisfactory. However, it is pointed out that these devices fail in cases of simultaneous troubles on different phases, but it is stated that polyphase failures are rare and can be further reduced by sufficient grounding of the towers. Low ground resistance must be provided for the towers, since the voltage after the insulator flashover is determined by this resistance. If the ground resistance is not low enough the voltage will rise in spite of a flashover and may cause serious troubles. Moreover, if lightning strikes a tower and the resistance is high the voltage difference between tower top and earth can be sufficient to cause flashover from the tower to phase wires and create traveling waves on the wires.

The value of ground wires is admitted to a certain extent as a means of protection against partial discharges with currents up to 1,000 amp., but it is pointed out that they are by no means sufficient compensation for a poor tower ground. If lightning hits a tower, the ground wire will have but little effectiveness in relieving the ground resistance and the danger of a flashover into the line remains, if the ground resistance is not low enough. It is also stated that ground wires are not a reliable protection of the line against lightning strokes and that when lightning strikes the ground wire a considerable distance from a tower a flashover to the line may occur, because for heavy discharges the ground wire will not be able to drain a considerable amount of the charge. The ideal arrangement would be a wire cage around the whole line, which, of course, is commercially impracticable.

For the station protection insulators on the terminals are recommended with a long breakdown lag and a high safety factor in comparison with the line insulators. It is also emphasized that the flashover voltage of the station insulators must be sufficiently above the voltage of the incoming waves at all instances of time, so that even in case of a voltage rise due to reflections, flashovers will be avoided. As to the best location for protecting equipment the line terminals are recommended.

For the time being, the following program for lightning protection at the station is outlined:

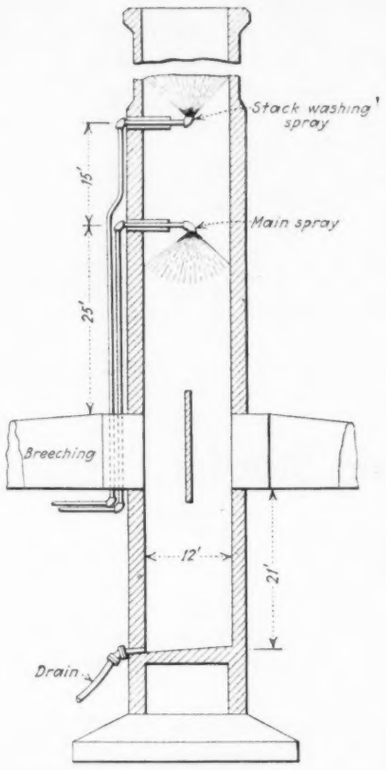
1. Flatten out the steep wave fronts by using condensers.

2. Reduce the crest of the voltage by use of condensers.

3. Reduce the tail of the wave by good grounding through insulators.

Regarding the last item, the author surprisingly advocates a ground resistance equivalent to the surge impedance of the line; that is, 500 ohms. He states, however, that lower values would be better, if some of the German rules did not require that the resistance withstand the currents for two minutes.

Stack Sprays Recover 35 per Cent of Fly Ash*



Typical arrangement of water sprays for fly ash recovery

WATER sprays installed in power plant stacks have proved an effective method for reducing the discharge of fly ash in pulverized-fuel operation in the experience of the Consumers Power Company. The fly ash discharge is still about 5 per cent of the coal fired, but in the Kalamazoo plant, where the system was first installed as an emergency measure, this was found to be quite sufficient, and as a result several of the company's other plants have been so equipped. The installation of the water spray at first caused serious corrosion in the stack lining and necessitated relining the stack with acid-resisting material.

The capacity of the main nozzle is about 30 gal. per minute at a pressure of 10 lb. per square inch, and tests

**Abstract from a paper "Recovery of Fly Ash from Pulverized-Fuel Stacks by Use of Stack Sprays," presented by J. W. Mackenzie at the recent convention of the American Society of Mechanical Engineers.*

Hourly Results of Tests

Test number	1	2	3	4
Number of boilers in use	2	2	2	1
Total lb. coal fired	23,183	17,711	16,888	11,644
Fly ash to stack, lb	1,951	997	1,498	1,299
Fly ash recovered, lb	756	674	463	437
Ratio, fly ash to coal, per cent	8.42	5.63	8.87	11.16
Carbon in fly ash, per cent	.....	49.0	35.9	40.4
Carbon in recovered fly ash, per cent	.....	46.2	37.4	46.8
Per cent of fly ash recovered	38.8	46.16	30.90	33.60

Per Cent Carbon and Fineness of Recovered Ash

Test No.		Per Cent Carbon	Through 200	Through 100	Through 48	Through 28	Over 28
5	With spray	34.0	61.1	86.6	98.8	99.9	0.1
	Without spray	56.4	27.3	56.2	93.4	99.6	0.1
6	With spray	38.8	73.5	93.0	99.6	99.9	0.1
	Without spray	48.3	48.6	75.4	97.4	99.8	0.2

indicate that an increase in the quantity of water has but little effect on the results.

There was found to settle upon the stack walls above the main spray a collection of fine moist ash which would eventually flake off and escape from the stack. Consequently the second, or stack washing spray, was installed. This is turned upward so that the water from it strikes the wall of the stack at a point above the ash deposit, and this water running down the stack washes the accumulation down. The use of the stack-washing spray twenty minutes a day is sufficient to eliminate all trouble from this source.

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Connected Load 2.5 Hp. per Plant Kw.

A KILOWATT of plant serves nearly 2.5 hp. of connected load; distribution transformers exceed the entire generating equipment in rating; energy sales correspond to 13 per cent average use of the connected load; miles of distribution lines (less than 20,000 volts) are 3.8 times the miles of high-tension lines on the system of the Pacific Gas & Electric Company, according to operating statistics given in its annual report for 1929, from which the following are abstracted. Other ratios will appear upon analysis of the figures:

Total plant rating, kw.	918,966
Hydro,	674,597
Steam	244,369
Connected load, hp.	2,249,206
Commercial and domestic lighting	751,735
Power	1,497,471
Energy sales, kw.-hr.	1,948,656,000
Distribution transformers, kw.	1,052,309
Miles transmission lines	3,831
Overhead and underground distribution (less than 20,000 volts), miles	14,657

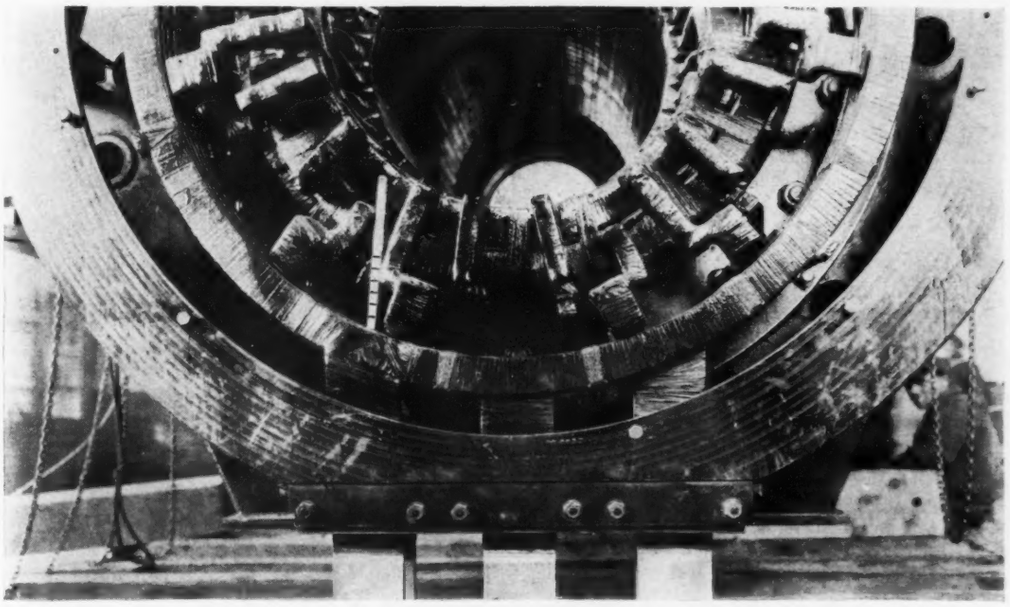
Generator Is Rated Nearly 10,000 Amp.

By W. F. DAWSON
General Electric Company, Lynn, Mass.

A GENERATOR having probably the largest amperage of any steam turbo-generator ever built has recently been installed by the Lone Star Cement Company, a subsidiary of the International Cement Corporation, in its plant at Hudson, N. Y. The actual current rating for 500 volts is 9,393 amp.; the normal rating of the unit is 6,500 kw. at 0.8 power-factor or 8,125 kva.

A few years ago a turbo-alternator running at 3,600 r.p.m. and having this enormous current capacity would not have been practical because of high load losses and excessive heating, but improvements made by the stranding and transposition of the armature windings and by the substitution of non-magnetic for magnetic materials at the ends of the armature, together with improved methods of ventilation, have made the generation of these huge currents at high speed not only possible but wholly practical. The insulation of both field and armature windings is composed entirely of mica and asbestos, the permitted temperature rise of which for field windings is 90 deg. C. or 162 deg. F. and for armature windings 80 deg. C. or 144 deg. F. The temperature rises after continuous operation at 480 volts and 9,790 amp. with a power factor of 0.8 were appreciably less than these values, there being a margin of 6 per cent in the heating of the field and 22 per cent in the heating of the armature windings. The full-load efficiency after counting out all the usual losses, the windage of the ventilation, bearing friction, etc., is 95.2 per cent.

All six of the massive armature leads, each composed of two copper straps 6 x $\frac{1}{4}$ in. in multiple, are brought to the connection board to permit the installation of suitable current transformers for differential protection before the leads are carried away to the switchboard. The largest output single generator ever built is rated 160,000 kw., hence its output is nearly 25 times that of the generator here described. Yet its current is only 8,100 amp. or 18 per cent less that of the 6,500-kw., 480-volt machine.



Largest low-voltage high-speed alternator has current rating of 9,790 amp. at 480 volts

Requirements of 20 Processes That Generator-Voltage

By S. MARTIN, JR.

Industrial Engineering Department, General Electric Company

AS POINTED out in the July 26 issue of ELECTRICAL WORLD, control of direct-current motor speeds and direction of rotation by varying the generator voltage and reversing its polarity has extensive industrial applications and is largely responsible for the continued and increasing favor of direct-current motors for some operations despite the almost universal supply of alternating-current service.

Six advantages were pointed out and the requirements of various processes in steel mills, paper mills, lift bridges, high-speed as well as freight elevators discussed to show how this method of control can be applied with effective results. In this, the conclusion of the former article, several other applications are considered.

Mule Haul and Car Dumper.—A lift and turn-over type of car dumper utilizes generator-voltage control independently for itself and for the "mule" haul which places the car on the dumper. After a car loaded with coal passes over the pit the mule pushes the coal car up the incline. Accurate speed control of the mule coming out of the pit, bumping the car, accelerating it up the incline, slowing down so that the coal car does not lose its contact with the mule and accurate placing of the car on the cradle of the dumper are the requirements of the electric equipment. Generator-voltage control meets these rigid requirements. Power economy, reliability and small electrical equipment are other advantages of the installation.

The car dumper requires accurate speed control to eliminate wear and tear on the equipment. When the car is being hoisted and has almost reached the top of the lift it must be slowed down to start rotation of the moving car without jarring it against the guides and pins which act as stops. When the car is being returned to the bottom of the lift the same requirements hold true, but in addition the cradle must be accurately placed ready to receive the next car. These requirements are met by generator-voltage control. In the car dumper installation two motors are used to provide uniform lifting forces on the ends of the cradle. The armatures of the generators and motors are connected in series and the fields of the generators in parallel to effect a saving in the copper used in the armature circuit. The motors and generators are electrical duplicates and are of such size that it will be possible to speed up the operation, if necessary, at a later date.

An outstanding example of this type is at Toledo, Ohio, where there are two equipments. For the general run of car the time required for the dumping is 50 to 55 seconds. Of course there is an overlapping of the time as the mule is working at the same time the lift and dumper are working. It is possible with one of these equipments to load a 10,000-ton boat in the short time of three to four hours.

Stokers.—Where three or more motors are used to operate stokers generator-voltage control enables the operator to make uniform and accurate adjustment of the system as a unit. Slight relative adjustments are made on each motor by means of field rheostats in their circuits.

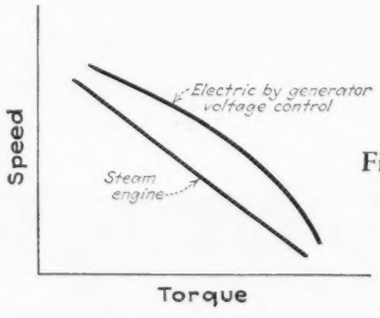
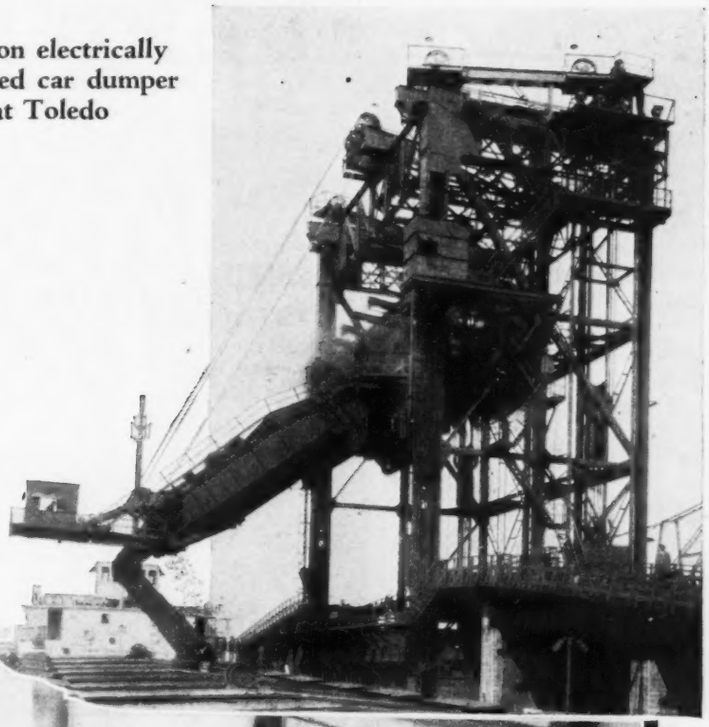


Fig. 1—Speed-torque characteristics of power shovel

Underfeed and overfeed stokers are not constant torque loads, so that the selection of the motor must be given careful consideration. Chain-grate stokers require a constant torque. Ordinarily rheostatic control would be used on single applications, but three or more units can be driven from a single generator with accurate and uniform fleet control through the generator field.

Cable Stranding Machines.—In cable stranding it is necessary to maintain constant torque to assure constant tension on the cable during both acceleration and deceleration. Rheostatic control does not operate smoothly enough to accomplish this satisfactorily, so the versatile generator-voltage control is applied. A generator is required for each motor. The Western Electric Company is an outstanding user of this type of equipment.

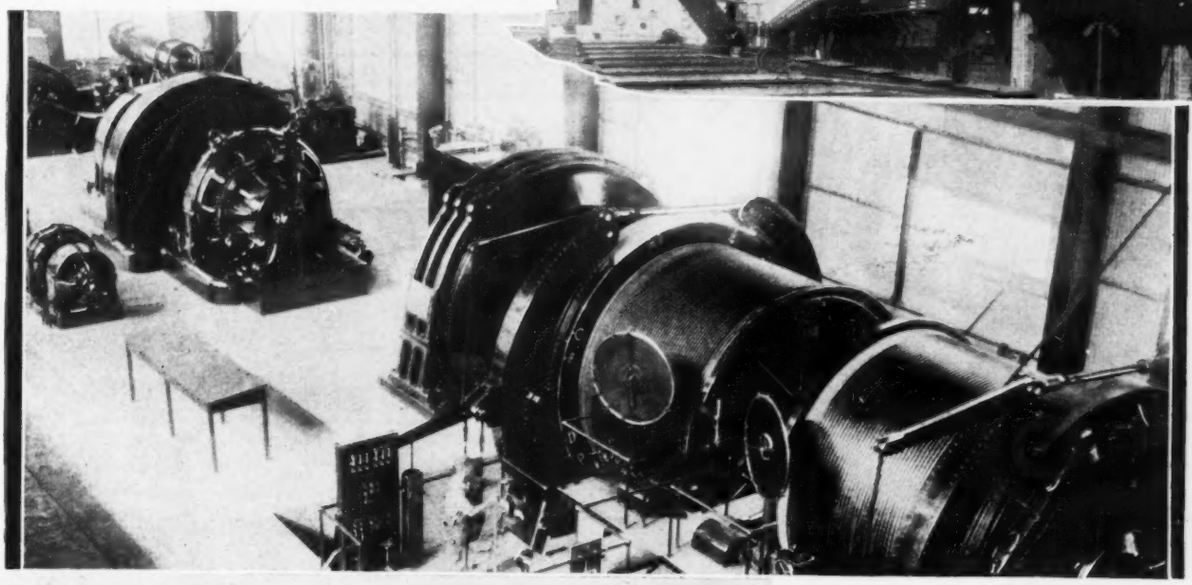
Power Shovels and Draglines.—Speed-torque curves for a power shovel are shown in Fig. 1, as obtained by a steam engine and generator-voltage control. If rheostatic control were used, the upper curve would be jagged



120-ton electrically operated car dumper at Toledo

Control Meets

instead of smooth. This would produce inaccurate operation of the shovel, as well as excessive maintenance. Contactors, relays, resistors and other auxiliary control which would vibrate and possibly shake to pieces and have to withstand ex-

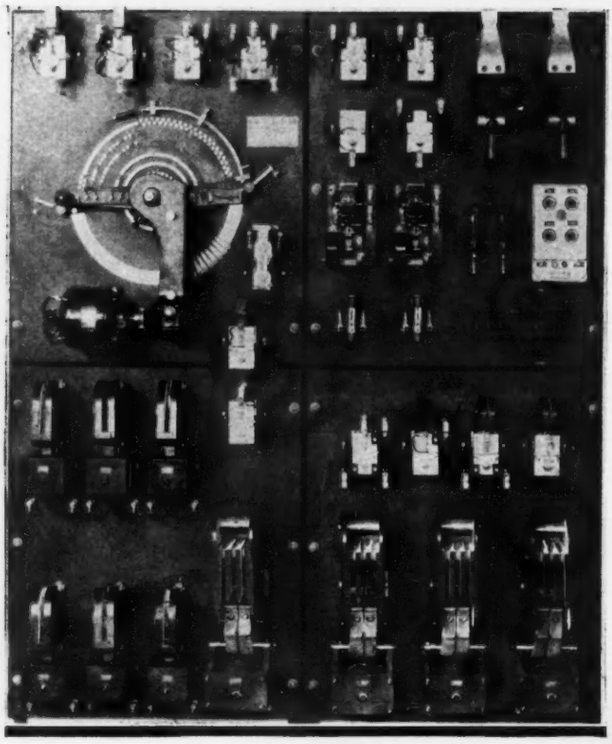


Electric ore hoist at Inspiration copper mine

15-cu.yd. electric shovel in Illinois coal fields

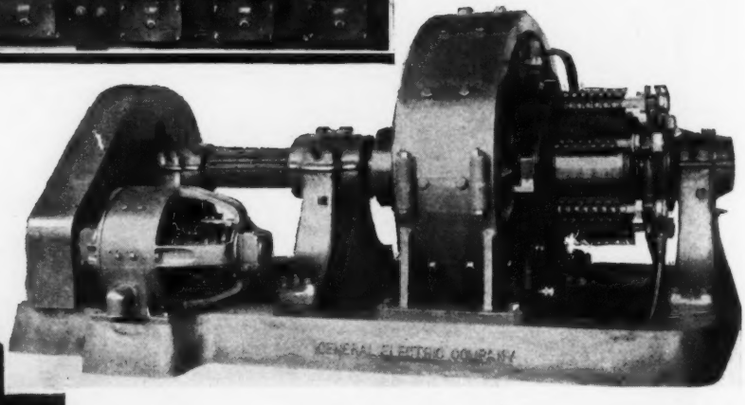
cessive wear, due to opening and closing operations several times per minute, are avoided by using generator-voltage control.

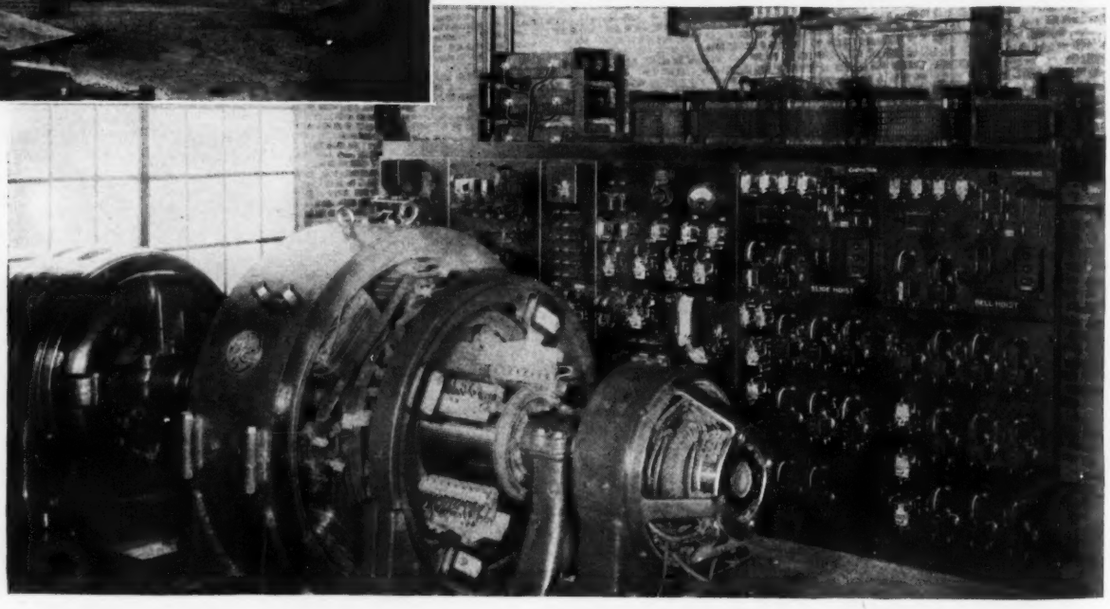
Hoisting, crowding and swinging operations each require one or two motors and a corresponding generator,



Skip hoist with Ward-Leonard control

Starting and running motors with full-automatic control for printing press





so five-unit synchronous motor-driven generator sets are required. A typical wiring diagram of a generator and motor for any one of the three motions mentioned is shown. In order to protect the equipment and prevent breaking the shovel, a sharp drooping characteristic is desired. This is obtained by having part of the shunt field self-excited and part of it separately excited. This type of installation lends itself to regenerative braking, which is used to very great advantage on shovels.

One of the largest shovels built to date is rated at 15 cu.yd. and has 5,500 hp. installed on it, or approximately twice the power of the next size shovel (12 cu.yd.). The large increase in power is to swing the larger loads over 35 per cent greater distance in the same time as the 12-cu.yd. shovel. It is used in coal stripping in the southern part of Illinois.

Mine Hoists.—The principal factors which justify generator-voltage control of mine-hoist equipment follow:

(a) Accuracy of control (desirable for high-speed hoists, rapid rate of hoisting or frequent shifting to other levels).
(b) Increased safety in operation.
(c) Higher efficiency on certain duty cycles.
(d) Feasibility of equalization of power demands.
(e) Possibility of elimination of gears.

In most respects the requirements are similar to those of a high-speed elevator, but there are one or two added features. A flywheel motor-generator set is often used to iron out the peak loads. The lowering of unbalanced loads without the use of the mechanical brakes is as readily accomplished as the hoisting. In this operation a large proportion of the energy available at the hoist motor coupling is returned to the power system. This manner of braking and the handling of negative loads relieves the hoist mechanism in a large measure from shock and strain, reduces the wear on brake shoes and prolongs the life of the mechanical parts in general. The outstanding advantage is the increased safety in operation.

Blast Furnace Skip Hoists.—Control of skip hoists must be adapted to a variety of loading rates, dependent on several conditions. Consequently it must have the following qualifications:

1. Broad speed range in order to obtain a sufficiently slow speed to land the bucket on the furnace top with one type of construction or to up-end the bucket in the other type.
2. Close speed regulation to obtain the same speed regardless of whether a coke or iron ore load is being dumped.
3. Smooth change of speed to prevent the bucket swinging during acceleration and retardation.
4. If the furnace burns fast or slow, the operation of the bucket must keep pace.
5. The d.-c. load in most steel mills is beyond the capacity of the mill. If generator-voltage control is used, an a.-c. driving motor can drive the generator.

The many inherent advantages of generator voltage control are also realized on an installation of this type. There is very little adjusting in installing or changing the equipment. Owing to the short haul and percentage of slow speed to high speed running power is saved. A large installation of this type at the Sparrows Point (Md.) plant of the Bethlehem Steel Company was described in the February, 1929 issue of *Iron and Steel Engineer.*

Dredges.—The dipper dredge is a veritable floating shovel and has similar requirements. In hydraulic dredges generator-voltage control is applied to the swinging motion only. This is similar to shovel motor-generator practice.

The Great Lakes Dredge & Dock Company has the largest dredges of these types in the world. The largest dipper type is Diesel-electric drive, has a 15-yd. bucket and uses 1,500 hp. in motors. The largest hydraulic dredge is rated 30 in. and uses 5,000 hp.

Specialties.—When the Baltimore & Ohio Railroad installed its car-washing equipment it did not know the most efficient speed for moving the Pullman cars through the automatic washer. To determine this an experimental installation using generator-voltage control was installed.

The New York *Times* has just installed five 200-hp. motors, using generator-voltage control for printing presses, the main reason being that only a.-c. power was available. In addition a wide speed range (9,000 to 60,000 copies per hour), had to be obtained. These requirements justified the expense involved in generator-voltage control.

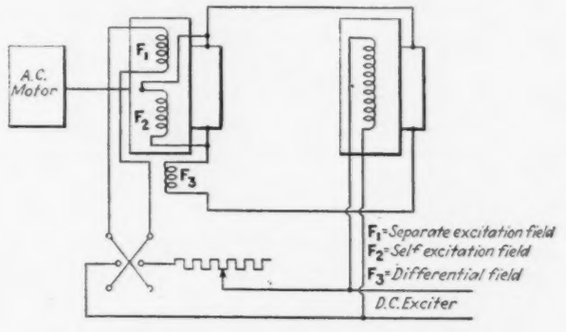


Fig. 2—Control for handling hoisting, crowding and swinging operations of power shovels

Another special application employed at present chiefly by automobile manufacturers is the use of generator-voltage control in connection with the dynamometer-testing equipment for testing gears, internal combustion engines, propellers and other equipment for automobiles and airplanes which require a wide speed range during their operation. Fineness of control to duplicate actual running conditions, accuracy in making tests and adaptation to preparing data are other essential requisites which are met successfully by generator-voltage control.

Summary

Thus, generator-voltage control is used for the large 7,000-hp. motor in the steel mill, for the small 3-hp. motor for the paper mill, for the elevator in office or factory, and even in the presence of coal for the operation of mine hoists and shovels. It is used because it has many outstanding characteristics, which can be summed up as follows:

Speed control over extremely wide ranges.
Smoothness of operation.
Flexibility.
Elimination of contactors and relays for handling large values of current.
Constant torque over wide speed range.
Regenerative braking.

Economies of Electric Traction*

FOR many years after the introduction of electric traction none of the various electrifications which were installed from time to time were initiated solely for reasons of economy. A larger part of these earlier projects were carried out principally for the elimination of smoke and soot and for the more expeditious handling of terminal passenger traffic. For these reasons there was little opportunity for setting up a convincing, direct comparison between the cost of steam and electric operation. More recently, with the adaptation of electric haulage to some of our main line roads, accurate and reliable figures have been compiled, detailing item by item the relative costs of steam and electric operation. Some of these are presented in the accompanying tables. Investment costs are also shown so that the net benefits resulting from the conversion can be analyzed.

The costs for handling 1,000 ton-miles of traffic by steam as shown in the tables range between $1.43 and $5.05, whereas those after electrification vary from $0.53 to $2.94. Conditions of profile, speeds, density of traffic

**Excerpts from World Power Conference papers by W. D. Bearce, transportation engineering department, General Electric Company.*

Installation Costs for Railroad Electrification

(Presented at World Power Conference by W. D. Bearce, General Electric Company)

	Butte, Anaconda & Pacific (1913)	C.,M.&St.P. Rocky Mountain-Missoula (1915)	C., M. & St. P Coast Division (1919)	Mexican Railway
Route-miles	30	438	210	64
Single-track miles	91	566	282	80
Power substation				
Buildings	$191	$535,157	$452,808	$686,919
Apparatus	118,950	1,859,353	1,476,964	.....
Power transmission	.....	715,181	549,521	263,130
Power distribution	357,009	2,890,615	2,190,401	633,327
Power line poles and fixtures	135,264	1,091,721	966,563	286,134
Signal system	.....	197,446	780,000	.....
Other expenses	47,176	452,216	762,734	157,427
Locomotives	553,000	.....	.....	1,580,000
Freight	.....	2,881,112	3,065,280	.....
Passenger	.....	927,408	1,035,690	.....
Switchers	.....	111,564	48,520	.....
Total	$1,211,590	$11,661,773	$11,328,481	$3,606,937
Per route-mile	**40,000**	**26,650**	**53,700**	**56,358**
Per single-track mile	**13,400**	**20,600**	**40,000**	**45,000**

COMPARATIVE OPERATING COSTS AND SAVINGS PER 1,000 TON-MILES

(Presented at World Power Conference by W. D. Bearce, General Electric Company)

	Costs		Saving	
Butte, Anaconda & Pacific Railroad (1913):	Steam	Electric	Amount	Per Cent of Steam
Enginemen	$0.71	$0.41	$0.30	42
Trainmen	1.00	0.67	0.33	33
Fuel or power	2.14	0.954	1.186	**55**
Repairs	0.85	0.535	0.315	37
Enginehouse	0.20	0.107	0.093	46
Lubricants	0.066	0.029	0.037	56
Other supplies	0.04	0.027	0.013	36
Water	0.034	0.007	0.027	**80**
Substations	.....	0.097	.....	..
Trolley and trans	.....	0.104	.....	..
Total	$5.05	$2.94	$2.11	42
Chicago, Milwaukee, St. Paul & Pacific Railroad (1923) Harlowton-Avery Div.:				
Enginemen	$0.258	$0.145	$0.113	43.5
Trainmen	0.217	0.142	0.075	34.5
Fuel or power	0.551	0.34	0.211	38
Repairs	0.433	0.15	0.283	**65**
Enginehouse	0.103	0.0386	0.064	62
Lubricants	0.008	0.0067	0.0013	20
Other supplies	0.011	0.003	0.008	**72**
Water	0.012	.....	0.012	..
Substations	.....	0.0484	.....	..
Trolley and trans	.....	0.029	.....	..
Total	$1.59	$0.903	$0.687	43
Othello-Tacoma Div.:				
Enginemen	$0.324	$0.183	$0.141	44
Trainmen	0.36	0.22	0.14	39
Fuel or power	0.69	0.43	0.26	38
Repairs	0.47	0.19	0.28	**55**
Enginehouse	0.081	0.043	0.038	**47**
Lubricants	0.008	0.007	.....	..
Other supplies	0.010	0.007	0.003	30
Water	0.017	.....	0.017	..
Substations	.....	0.085	.....	..
Trolley and trans	.....	0.05	.....	..
Total	$1.96	$1.22	$0.74	38

			Saving	
Paulista Railway (1927):	Steam	Electric	Amount	Per Cent of Steam
Enginemen	$0.425	$0.12	$0.305	72
Trainmen	.....	.....	.....	..
Fuel or power	1.73	0.25	1.48	**85**
Repairs	0.267	0.045	0.222	**83**
Enginehouse	0.328	0.0655	0.263	80
Lubricants	0.05	0.01	0.04	79
Other supplies	0.14	0.050	0.09	65
Water	.....	.....	.....	..
Substations	.....	0.056	.....	..
Trolley and trans	.....	0.055	.....	..
Total	$2.94	$0.652	$2.288	78
Mexican Railway (1928):				
Enginemen	$0.248	$0.117	$0.131	53
Trainmen	0.174	0.086	0.088	50
Fuel or power	0.401	0.249	0.152	38
Repairs	0.545	0.048	0.497	**91**
Enginehouse	0.031	0.015	0.016	50
Lubricants	0.026	0.0007	0.025	**97**
Other supplies	..	.....	.....	..
Water	.....	.....	.....	..
Substations	.....	0.017	.....	..
Trolley and trans	.....	0.007	.....	..
Total	$1.43	$0.534	$0.90	62
Combined results. (Totals not unit figures):				
Enginemen	$1,415,283	$685,792	$729,491	51.5
Trainmen	1,128,539	664,787	463,752	41
Fuel or power	3,466,385	1,570,367	1,896,018	55
Repairs	2,108,437	632,260	1,476,077	**70**
Enginehouse	533,307	184,071	349,236	65.5
Lubricants	82,932	33,184	49,748	60
Other supplies	117,199	44,353	72,846	62
Water	48,406	1,194	47,212	**97.5**
Substations	.....	231,884	.....	....
Trolley and trans	.....	154,072	.....	....
Total	$8,900,488	$4,202,064	$4,698,424	52.7

and other physical factors influence these costs, but on similar roads the comparisons should be assumed most accurate.

All operating figures except those for the Paulista Railway are based on conditions immediately preceding and following electrification. In the case of the Paulista road, the data refer to results on steam and electric divisions having similar profile and train service. The tonnage handled by the Butte, Anaconda & Pacific Railroad under electric operation was somewhat heavier, but adjustment has been made. The saving in crew wages is due to operating heavier trains at higher speeds with single crews. The operating results for the Chicago, Milwaukee & St. Paul Railroad are based on one 141-mile division (formerly four steam divisions) and one 220-mile division (formerly two steam divisions). Note the high percentage saving in repairs. Maintenance of substations and distribution on the Paulista and Mexican railroads is relatively small.

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Three-Frequency Supply for Industrial Plant

By F. H. PENNEY

Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

A PROMINENT body builder in the automotive field required a converter set which would provide three different frequencies simultaneously or singly in accordance with the load demand. The load consists of groups of motors, some of which demand part-time operation at a frequency above the general purpose supply and at other intervals operate at the commercial frequency. Another portion always operates from one of the higher frequencies.

The set consists of a 125-hp., 1,200-r.p.m., 0.8 leading power factor synchronous driving motor, to each end of which is coupled an induction type frequency converter. The stators of the three units were specifically designed for the general purpose supply of 480 volts, three phase, 60 cycles.

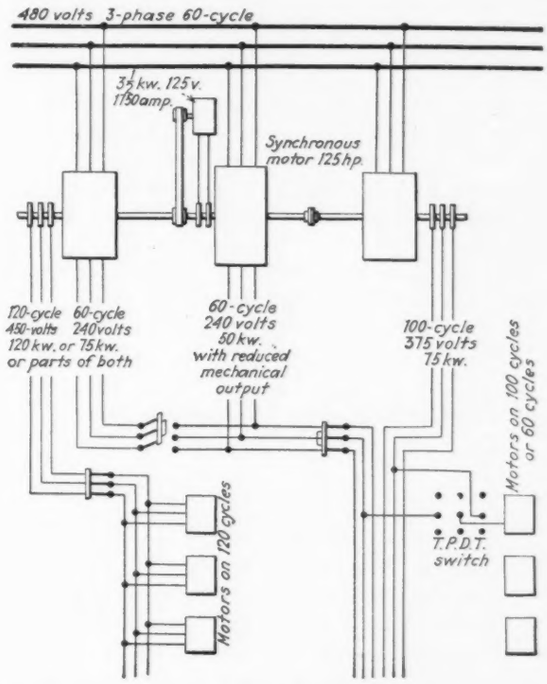
One generating unit was designed to serve as a combined auto-transformer and frequency converter with a capacity from the slip-ring circuit of 120 kw., 0.8 power factor, three phase at 120 cycles, 450 volts, or from taps on the stator winding of 75 kw., 0.8 power factor, three phase at 60 cycles, 240 volts. The stated capacity is on the basis of load on one circuit at a time, though the power may be taken from the two circuits simultaneously. However, 50 per cent load on one circuit limits the other to 50 per cent of rated output when both circuits are delivering power.

The second generator was designed to provide energy from the slip-ring circuit only and has a capacity of 75 kw., 0.8 power factor, three phase, 100 cycles, 375 volts.

The stator winding of the synchronous driving motor is arranged to act as an auto-transformer to provide 50 kw., 0.8 power factor, 240 volts, three phase, 60 cycles. The rated output in both cases is on the basis of energy from one source at a time, though fractional mechanical and electrical outputs are obtainable simultaneously.

The exciter for the driving motor is belt-driven from one of the couplings between the motor and a generator. This method was selected to avoid making the set too long. The exciter is rated 3½ kw., 125 volts, 1,750 r.p.m.

The motor control is of the full-voltage type and starting and stopping are accomplished by merely pressing "start" and "stop" buttons. The requisite overload protection and undervoltage release is also provided. By virtue of a simple connection, the two triple-pole magnetic switches controlling the polyphase input to the converters are interlocked, so that the power will be cut off the converters whenever the driving motor is shut down. Individual overload protection is also provided for the converters.


480 volts 3-phase 60-cycle
3½ kw. 125 v. 1750 amp.
Synchronous motor 125 hp.
120-cycle 450-volts 120 kw. or 75 kw. or parts of both
60-cycle 240 volts
60-cycle 240 volts 50 kw. with reduced mechanical output
100-cycle 375 volts 75 kw.
Motors on 100 cycles or 60 cycles
T.P.D.T. switch
Motors on 120 cycles

Scheme for supplying 120-cycle energy to one group of motors and 60-cycle and 100-cycle energy to other apparatus

The accompanying schematic wiring diagram shows a typical method of utilizing the energy from a set of this character. In this scheme the 120-cycle energy is served to one group of motors, while both the 60-cycle and 100-cycle power are usually served to certain machines. Machines having dual power service are normally equipped with 220-volt, three-phase, 60-cycle motors which may be supplied to either circuit if a triple-pole, double-throw switch is employed. Machines in this group, having dual power service, are in a better position to meet a variety of operating conditions than is the machine having single service only.

It will be obvious that the 220-volt energy is secured without the expense of transformers or the necessity of providing floor space. Further, no extra control is necessary, which is quite an item, since the dual service is today considered practically a necessity.

BOOK REVIEWS

Photo Cells and Their Application

By V. K. Zworkyin, Ph.D., and E. D. Wilson, Ph.D., Westinghouse Research Laboratory. New York: John Wiley & Sons, 209 pages. Price, $2.50.

Due to the increasing interest in the applications and use of photo cells the engineer will find this book a valuable addition to his library. The authors give a brief historical introduction leading to the first practical cell. The chapters following cover the general theory of radiant energy and photo-emissive effect; the mechanical features of cells; methods of preparing photo cells; the vacuum photo cell; gas-filled photo cell, photo-conductive and photo-voltaic cell; typical photo cell circuits used in connection with the radio tube; the problem of amplification, in which various types of circuits using cells are explained, with suitable diagrams; the use of photo cells in sound movies; the photo cell in facsimile transmission and in television; miscellaneous application for photo cell use. The authors make a brief forecast of photo cells in the future. The appendix of this book gives some definitions concerning illuminating engineering nomenclature and photometric standards.

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Elektrobetrieb In der Textilindustrie

By William Stiel. Leipzig, Germany: S. Hirzel. 636 pages.

The subject is presented in a detailed and comprehensive manner and may be considered a valuable addition to the literature of this great industry. The author is chief engineer of a major division of the Siemens-Schuckert Company, Berlin, Germany, and he has naturally drawn upon the accumulated information and experience available there. However, he has not limited himself to the data of his own company, but through the co-operation of prominent engineers with competing concerns, such as the Brown-Boveri Company and the Allgemeine Electricitäts-Gesellschaft, has been able to draw upon their data as well.

Although it is a substantial volume, its author does not pretend that it is a complete exposition of the subject, but he presents it as an up-to-date contribution of the most interesting developments, constructions and trends in the industry.

The subject of process steam supply, although not directly included under the title of electric drives, is discussed in the section devoted to power stations and prime movers. This is an indication of the author's effort to treat his subject with traditional German thoroughness.

Variable speed spinning receives considerable attention. The description of motor constructions for rayon-pot spinning is also an interesting part of this book. The carefully prepared operation or process diagrams are very instructive, particularly to the beginner. There is, however, no mention made of full-fashioned hosiery knitting machines and their operations. This subject is presumably less important in Europe than in this country and the omission undoubtedly is expedient, since it does not seem possible to discuss every textile application in one book.

This book should prove of great value to all who are interested in this subject and who possess a reading knowledge of the German language.

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X-Rays

By B. L. Worsnop. New York: E. P. Dutton & Company. 101 pages. Price, $1.10.

One in search of a brief and compact summary of X-rays will find in this little volume the steps in the development of the mechanism and technique of X-rays. The pioneer experiments are recorded; the connection with crystallography, wave-length determinations, dispersion, emission, absorption, ionization, refraction and reflection comprise the phases discussed for the benefit of the medico or the physics student.

▼

Structural Aluminum Handbook

Compiled by the technical staff of the Aluminum Company of America, Pittsburgh, Pa. 119 pages. Price, $1.

The issuance of this reference book offers further evidence of the thoroughness and scientific manner in which the Aluminum Company of America is conducting its program of development and expansion. A few years ago metal construction connoted the almost exclusive employment of steel. This volume, of handy dimensions and excellent typographical appearance, provides the data needed by engineers who are interested in the application of aluminum for the increasing number of purposes for which it is being adopted.

A brief description of the composition of structural-aluminum alloys is followed by data on mechanical properties and detailed information of value to structural engineers. Tables of areas and weights, formulas, dimensions, conversion factors and other useful matter complete a volume that will prove a useful addition to the engineer's library.

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Eiserne Gittermaste für Starkstrom-Freileitungen

By Wilhelm Taenzer. Berlin: Julius Springer. 65 pages (8¼x11¾ inches), 209 illustrations. Price, 13.50 reichsmarks.

Teaching by example rather than by precept, the verbal text of this book is limited almost entirely to a few introductory pages. The first five are devoted to an abstract of present (German) official specifications for the construction of power lines. There follows a short discussion of fundamental economic and engineering considerations in their design. The rest is illustrative problems. Computations are carried through, in detail but very compactly, for a number of different types of lattice tower. It would seem that with these as models no difficulty should be encountered with other types. Instead of explanatory statements, diagrams have been used without stint. Tower designers and students of design should find material here that will interest them.

Men of the Industry

Georgia Power Shifts District Managers

JAMES A. SIMMONS, formerly district manager of the Statesboro district of the Georgia Power Company, has been transferred to Waynesboro as district manager; L. J. PORTER, formerly manager for the Waynesboro district, has been transferred to be manager of the Thomson district; J. R. VANSANT, formerly manager of the Swainsboro district, will take charge of the Statesboro district, and E. W. CARRINGTON, formerly district manager at Winder, has been moved to Cornelia to succeed W. R. BOWER, who has been granted an extended leave of absence because of illness.

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R. M. HARDING, formerly vice-president and general manager of the Columbus (Ga.) Electric & Power Company, will become divisional manager of the Columbus division of the Georgia Power Company, following the consolidation of these two companies.

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J. FRANKLIN POND, who has been manager of the Petersburg, Va., district of the Virginia Electric & Power Company for some years, has been promoted to district manager of the Petersburg-Hopewell district. Mr. Pond entered the service of the company in 1903.

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ROBERT H. MANGUM, formerly assistant manager of the investment department, has been named manager of the publicity department of the Alabama Power Company. He succeeds W. J. BALDWIN, who has been appointed publicity manager for the Commonwealth & Southern Corporation. Mr. Mangum has been connected with the power company since 1927, when he joined the investment department.

•

LOUIS C. SMITH, manager of the Schenectady division of the New York Power & Light Corporation, has resigned to accept an executive position with the Pennsylvania Mutual Life Insurance Company of Philadelphia. Mr. Smith has been identified with upstate utilities since 1912, when he removed to Gloversville from his native state, Pennsylvania. He was president of the Fulton County Gas & Electric Company at the time of the organization of the New York Power & Light Corporation in 1927. He continued at Gloversville as manager of the Mohawk division of the company until June 1, 1929, when he was appointed manager of the Schenectady division.

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T. O. Kennedy Heads Commercial National Section

T. O. KENNEDY, vice-president and general manager of the Ohio Public Service Company, Cleveland, has been appointed chairman of the Commercial National

Section of the National Electric Light Association. The name of Ted Kennedy, as he is familiarly known, has been intimately associated with public utility affairs and there have been few activities in the electrical industry in which he has not been a participator or in which his influence has not been felt. Since being graduated from the University of Missouri in 1907, Mr. Kennedy has been associated with the Doherty interests in the construction, operating and managing divisions of public utility properties. He first served with the Denver Gas & Electric Company, then with the Montgomery Light & Water Power Company of Montgomery, Ala., and then with the Lincoln Gas & Electric Company, Lincoln, Neb. He spent two years on the work of constructing the hydro-electric development of the White River in Missouri, following which he went to the New York office of H. L. Doherty & Company, in general charge of all construction work. In 1914 he was sent to Massillon, Ohio, as general manager of the Massillon Gas & Electric Company, and in 1917 he returned to Denver as general superintendent of the Denver Gas & Electric Company. In 1922 he was sent to Cleveland as vice-president and general manager of the Ohio Public Service Company, the position he now holds.

Mr. Kennedy has devoted himself unstintingly to association and civic interests. Since establishing residence in Ohio he has been president of the Ohio Electric Light Association and chairman of the Ohio Committee on Public Utility Information. While in Denver he served as president of the Rocky Mountain Division of the N.E.L.A., president of the Electric Co-operative League and as chairman of the Rocky Mountain Committee on Public Utility Information.

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FRANK B. MOORE, formerly illuminating engineer of the Erie County Electric Company, Erie, Pa., has been appointed sales engineer of the Erie Electric Sales & Service Company.

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W. H. KENDRICK has been made general superintendent in charge of operations of all departments of the Broad River Power Company, a part of the Associated Gas & Electric System, with headquarters in Columbia, S. C. Mr. Kendrick is a graduate of Purdue University, receiving his electrical engineering degree at the Indiana institution in 1911. Immediately after graduation he entered the employ of the Bell Telephone Company at Chicago, remaining with this company until 1919, when he became connected with the General Gas & Electric Corporation, which is now a part of the Associated System. After serving in the capacity as engineer with the Metropolitan Edison Company, Reading, Pa., and the New Jersey Power & Light Company, Dover, N. J., other General Gas & Electric Corporation subsidiaries, Mr. Kendrick went to South Carolina in 1926 to be connected with the Southern properties of this company. He was in Spartanburg until 1927, when he moved to Columbia as engineer in charge of operations for the Broad River Power Company.

F. Heydecke New Chairman of Accounting Section

FRANKLYN HEYDECKE, who was appointed chairman of the National Accounting Section of the National Electric Light Association, as announced in the July 26 issue of the ELECTRICAL WORLD, has been more than 30 years in the continuous employ of the Public

Service Corporation of New Jersey and predecessor companies. During this period of time he has enjoyed the enviable record of having at one time or another filled almost every position in the general accounting and auditing department. Starting as clerk with the Essex & Hudson Gas Company in 1900, Mr. Heydecke later was sundry sales bookkeeper, and when the Public Service Corporation of New Jersey was formed, in 1903, he was transferred to its general office. From 1912 to October 1, 1924, he was auditor of the electric department, and on the latter date he became general auditor. He has always been interested in educational work, has taught several classes in accounting and is at present chairman of the Public Service company's committee on educational work, as well as being a member of several other committees.

Mr. Heydecke has been prominently identified since 1908 with the activities of the Accounting Section of the National Electric Light Association, has written several papers on accounting subjects and in addition to having served on a number of committees he originated and was chairman for two years of the committee on preservation of records, served on the original committee which drafted the uniform classification of accounts and on the committee which drafted the accounting procedure for merchandise sales, as well as on the committee which drafted the accounting educational courses and later on the revision committee which revised the courses.

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C. O. WILLIAMS of Syracuse, N. Y., has been appointed industrial electric representative of the Niagara-Hudson Power Corporation with headquarters in the Watertown territory. Mr. Williams was previously connected with the Syracuse office. He will have charge of developing new business in the electrical field in this section.

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HARLEY L. CLARKE of New York and Chicago has been elected a member of the board of directors of the American Arbitration Association. Mr. Clarke is president of the Utilities Power & Light Corporation of Chicago and heads the group which has recently taken over the Fox Film Corporation and its subsidiary interests. He is also identified with many power and public utility interests throughout the country and has for several years served on the American Arbitration Association's National Panel of Arbitrators for Chicago.

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D. C. DAVIS, assistant treasurer of the General Electric Company, has retired, after 41 years of continuous service with the company. Mr. Davis was born in Fort Wayne, Ind., November 26, 1870. He was formerly connected with the Fort Wayne Electric Works as assistant treasurer in charge of credits and collections. He removed to Schenectady in June, 1909, as general credit manager.

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OBITUARY

HUNTINGTON JACKSON, senior partner of the brokerage house of Huntington Jackson & Company, New York, and a member of the board of directors of the Crocker-Wheeler Electric Manufacturing Company and of other industrial enterprises, died suddenly August 4 at Long Beach following a brief swim in the ocean. Mr. Jackson was in his fifty-first year.

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FRANK J. OAKES, general superintendent of the Dodge works of the Link-Belt Company, Indianapolis, Ind., died suddenly at his home, July 19, of apoplexy. Mr. Oakes, who was 54 years of age, was well known in the mechanical engineering field. He entered the service of the Link-Belt Machinery Company, Chicago, in 1894. After serving in various capacities, in August, 1913, he was transferred to Philadelphia, from where he was transferred two years later and made general superintendent of the Dodge Works, Indianapolis, which position he held at the time of his death. Mr. Oakes was a recognized authority on mechanical engineering and during the World War was selected by the government as a designer and adviser on the manufacture of munitions. He was sent to Europe by the Link-Belt Company to investigate new mechanical inventions and to study chain manufacturing processes. He was a pioneer in developing processes for the heat treatment of steel and contributed valuable information to heat treaters as a result of his experiments. He also held patents on inventions in the chain industry and in other fields.

W. W. PATRICK, a director of the Foxboro Company, died suddenly, July 11, of pneumonia. He was one of the most widely known figures in the instrument business. He had been associated with the founders of the Foxboro Company since 1899. In 1908 he became New York district sales manager and held that position for 22 years. Mr. Patrick was also a prominent figure in the Association of Scientific Apparatus Makers of America. He was a director of the association and chairman of the industrial instrument section.

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RICHARD SUTRO of the banking house of Sutro Brothers & Company, New York, and a director of many public utility and industrial corporations, died August 3 at his residence in Port Chester, N. Y., in his sixty-seventh year. After receiving his education at the College of the City of New York, he entered the banking business and later associated himself with railroad companies and public utility enterprises. He was chairman of the finance committee and a member of the executive committee of the Connecticut Electric Service Company, held similar positions with the Connecticut Light & Power Company and was chairman of the board of directors of the Connecticut Electric Syndicate. At the time of his death he was a director of the Denver & Rio Grande Railroad and a member of the executive committee of the Pittsburgh & West Virginia Railway. He was also on the boards of the Pierce Oil Corporation, Southern Agricultural Chemical Company and the Tennessee Copper Company.

Financial and Statistical News

CONTINUANCE of unusual ease in the money market has been slow to pass itself on to the securities markets, although high-grade bonds have felt the effect in greater buying and slightly firmer prices. The buying public is rather definitely discriminating between new flotations of highest and secondary grade bonds. The latter move slowly, unless there is a common stock call feature.

——UTILITY REPORTS FOR THE FIRST HALF YEAR show that earnings average about 4 per cent over 1929 figures.

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Customer-Ownership Sales Quiet in May

AFTER AN UPWARD TREND during the first four months of the year, which brought April sales to a point well above the monthly average for recent years, sales of electric light and power company stock to customers, employees and other local parties dropped to $8,850,000 in May. The number of shares sold amounted to 109,400 and the number of transactions 15,100. The value is the lowest reported since November of last year. However, the average for April and May combined this year exceeded $15,000,000.

Sales were generally inactive. There is no record of large campaigns. The largest sale reported by any one company was about $750,000. Three other companies had sales of about $500,000. This is in marked contrast with the previous month, when one company selling stock around $25 per share reported sales of about $7,700,000, another company selling $100 shares had sales of more than $2,000,000 and two others exceeded $1,000,000 each. The combined sales for the same four companies during May were less than $1,500,000.

The estimated national totals here given are based on monthly returns received by the ELECTRICAL WORLD from central-station companies throughout the United States.

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Chase-Harris Forbes Fusion Segregates Utilities

ASSEMBLING UNDER ONE SPONSORSHIP a $5,000,000,000 utility group, the Chase-Harris Forbes affiliation has significance beyond merely the union of a national bank and a nationally known investment banking institution. The utilities involved serve large areas in all sections of the United States and in Canada. Furthermore, unconfirmed rumor has it that heavy investments may be made in certain utility situations abroad.

The utility systems which the Chase organization has helped to finance include International Paper & Power system, Brooklyn-Manhattan Transit system and others. The Harris-Forbes group, through United States Electric Power, is heavily interested in the Standard Power & Light system and American Water Works & Electric. It has been prominent in the financing program of Cities Service, North American Light & Power and Southern California Edison. Public Utility Holding Company also has substantial foreign utility properties and interests.

While there is no likelihood at the moment of any further physical or financial consolidation among these properties, the step suggests co-ordinated banking support behind this very substantial proportion of America's public utility systems.

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Receivership Filed for Atlantic Public Utilities

EASTERN STATES PUBLIC UTILITIES, INC., has filed receivership bills against Atlantic Public Utilities, Inc., Atlantic Public Service Associates, Inc., and the North American Water Works & Electric Corporation. The complaint made is that the three corporations are insolvent and that a receivership is necessary to safeguard the interests of stockholders and creditors. Answers have been filed by the defendants admitting the charge and consenting to the appointment of receivers. Clarence A. Southerland, former Attorney-General of Delaware, and Ralph J. Ritchie of Asbury Park, N. J., were appointed receivers.

The three corporations named control more than 120 subsidiaries with a stated value of over $60,000,000. Eastern States Public Utilities, Inc., controls Atlantic Public Utilities, Inc., which controls Atlantic Public Service Associates. North American Water Works & Electric is a subsidiary of the latter.

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Insull Indiana Properties Are Realigned

NEW alignment of their Indiana properties designed to promote capital simplification and to co-ordinate operations is undertaken by the Insull interests. The changes planned involve revamping of the capital structure of the State Line Generating Company, creation of the Indiana Railroad as a subsidiary of Midland United and the building of long-distance gas pipe lines.

State Line Generating Company is owned directly or through subsidiaries by a group which has contracted for the entire output of the company. These include Commonwealth Edison Company, Public Service Company of Northern Illinois, Northern Indiana Public Service Company and Interstate Public Service Company. The first unit of the State Line Generating station was placed in operation last year and a second and third are now planned.

Financing required for completion of the undertaking has already been planned. The company has asked for authority to issue and sell $15,000,000 of first mortgage 4½ per cent gold bonds, series A; $8,000,000 of five-year 5½ per cent gold debentures, and 717,600 shares of common stock of no par value, to yield not less than $7,176,000.

As announced last week, the Midland United Company has practically completed reconstruction of the electric transmission systems in Indiana, linked with those in neighboring states, and is also seeking simplification of its capital structure by offering an exchange of its shares, under alternate plans, to stockholders of the American Public Utilities Company, a subsidiary company almost wholly owned by Midland United.

New Capital Issues

FIRST MORTGAGE GOLD BONDS of the Eastern New Jersey Power Company have been issued to the amount of $3,140,000, the price being 100 and accrued interest. These securities, dated January 1, 1929, mature January 1, 1959. Proceeds from the sale of this issue will be used to reimburse the company, in part, for additions, extensions and improvements to its properties, including a new electric generating station at Sayreville, N. J., and for other corporate purposes.

Ontario Power Service Corporation, Ltd., a subsidiary of the Abitibi Power & Paper Company, Ltd., made an offering of 5½ per cent first (closed) mortgage sinking fund gold bonds, the price being 94.22 and accrued interest, to yield 6 per cent, a piece of financing involving the substantial sum of $20,000,000. Proceeds of this financing will be used to construct a new hydro-electric plant in Canada, virtually all of the output of which will be taken under contract by the Hydro-Electric Power Commission of Ontario and Abitibi Power & Paper Company.

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NEWS BRIEFS

Stockholders of the North American Company at a special meeting held August 7 approved the extension of the company's charter from 1940 to 1990 and approved other amendments which were outlined in the June 28 issue of the ELECTRICAL WORLD. The authorized common stock was increased from 10,000,000 shares of no-par value to 50,000,000 shares of no-par value. The 1,393,322 shares of authorized but unissued 6 per cent preferred stock of $50 par value were changed into a like number of shares of no-par value serial preferred stock and these shares were increased to 5,000,000.

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Stockholders of the Niagara Hudson Power Corporation at a special meeting held July 28 approved an increase in authorized capitalization by 5,000,000 no-par preferred shares and 150,000 shares of employees' convertible preferred stock.

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The board of the Syracuse Lighting Company has announced that John Costello of Syracuse, N. Y., and G. H. Garrison of Cortland, have been elected directors of the company. Mr. Costello is general manager of the Syracuse Lighting Company, and Mr. Garrison is president of the Cortland County Traction Company.

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Utility Securities Called for Payment

AMONG THE SECURITIES CALLED for payment in August in advance of maturity are the following:

	Due	Amount
Central Hudson Gas & Electric, deb. 6s	1935	$1,200,000
Coast Counties Light & Power first 5s	1946	689,000
Georgia-Alabama Power ref. 6½s*	1957	349 500
Great Consolidated Elec. Pwr. 7s*	1944	350,000
Berlin City Electric 6½s*	1959	89,000
Connecticut Light & Power B 5½s*	1954	70,000
St. Lawrence Power 6s*	1935	12,000
Princeton Light, Heat & Power 5s*	1939	10,000

*Not entire issues.

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Utilities Maintain Their Earnings

A STUDY of the half year's business operation in the various fields contrasting the position of the utilities with that of the railroads and industrials reflects very favorably on the former. Figures now available for the first half year show that the railroads have lost about one-third of their net operating revenue. In the industrial field a shrinkage of something like one-fifth or probably one-quarter in net earnings is shown. In the utility field, on the other hand, although there naturally has been a decline in the revenue increase from 1929 figures, the totals are still about 4 per cent above those of 1929, an abnormally favorable year.

The accompanying table showing the earnings of a group of utilities for the year ended June 30 illustrates pretty well the range of increase or decrease in earnings in comparison with the previous twelve months. While the average change is an increase of less than 10 per cent, there were some unusually large increases, such as that of American Commonwealth Power Corporation and Associated Gas & Electric Corporation, in both of which cases, presumably, additional properties are included. The effect of the depressed business conditions, however, is not lacking, as there are more minus returns than is normally the case. Most of these, however, are less than 5 per cent, which may be assumed to represent nothing more than the decline in general business during the period.

CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

	1930	1929	Per Cent Increase	Operating Ratio 1930	Operating Ratio 1929
American Commonwealths Power (Year ended June 30)					
Gross earnings	$27,326,576	$20,449,320	33.6	58	54
Net earnings	12,608,864	8,495,130	48.6	..	..
Associated Gas & Elec. System (Year ended June 30)					
Gross earnings	106,546,383	61,560,693	73.0	50	54
Net earnings	53,239,151	28,196,556	89.0	..	..
Baton Rouge Electric (Year ended June 30)					
Gross earnings	1,333,508	1,183,238	12.6	..	..
Net earnings	484,407	455,280	6.4	..	..
Carolina Power & Light (Year ended June 30)					
Gross earnings	8,906,731	9,259,876	—4.0	45	46
Net earnings	4,857,581	5,047,421	—4.0	..	..
Central Arizona Light & Power (Year ended June 30)					
Gross earnings	3,193,123	2,583,561	24.0	60	60
Net earnings	1,283,184	1,050,168	22.0	..	..
Eastern Texas Electric & Constituent Cos. (Year ended June 30)					
Gross earnings	10,104,259	8,954,072	12.8	..	..
Net earnings	4,210,225	3,762,154	12.0	..	..
Eastern Utilities Associates (Year ended June 30)					
Gross earnings	9,383,840	8,948,132	4.9	..	..
Net earnings	3,804,217	3,498,991	8.7	..	..
El. Paso Elec. & Constituent Cos. (Year ended June 30)					
Gross earnings	3,627,402	3,340,656	8.5	..	..
Net earnings	1,573,415	1,384,091	13.7	..	..

	1930	1929	Per Cent Increase	Operating Ratio 1930	Operating Ratio 1929
Galveston-Houston Elec. & Subs. (Year ended June 30)					
Gross earnings	5,028,577	5,246,861	—4.2	..	..
Net earnings	1,566,261	1,711,274	—8.5	..	..
Kansas City Power & Light (Year ended June 30)					
Gross earnings	14,637,949	14,239,574	2.8	50	52
Net earnings	7,402,458	6,993,419	5.9	..	..
Nevada-California Electric (Year ended June 30)					
Gross earnings	5,674,201	5,469,394	3.7	49	46
Net earnings	2,909,725	2,958,402	—1.6	..	..
North American & Subsidiaries (Year ended June 30)					
Gross earnings	147,278,311	142,545,550	3.3	51	52
Net earnings	71,515,070	68,384,529	4.6	..	..
Puget Sound Power & Lt. & subs. (Year ended June 30)					
Gross earnings	16,926,533	15,717,242	7.6	..	..
Net earnings	7,186,895	6,555,601	9.6	..	..
Southern California Edison (Year ended June 30)					
Gross earnings	40,794,717	37,310,785	9.0	33	34
Net earnings	27,090,615	24,346,175	11.0	..	..
Tampa Electric (Year ended June 30)					
Gross earnings	4,580,852	4,595,139	—0.3	..	..
Net earnings	1,521,669	1,463,795	3.9	..	..
Virginia Electric & Power & Subs. (Year ended June 30)					
Gross earnings	17,187,585	16,708,322	2.8	..	..
Net earnings	7,771,065	7,431,434	4.5	..	..

Bonds Tend Upward

TEN bullish influences operating in the direction of higher prices for bonds at this time are summarized by Hale, Waters & Company, in part, thus:

1. *Cheap Money.*—The cheapness of money at this time is emphasized by a 2½ per cent Federal Reserve Bank discount rate, the lowest in the history of the system; 2 per cent bankers' acceptance rates, 3 per cent commercial paper, and 2 per cent call loans. Since the purchaser of a bond is in effect the purchaser of a given income the cost of the bond is in reality a price for the income. Bond prices are always responsive therefore to cheap money. Cheap money tends to drive capital into the bond market and force prices up with a corresponding lowering of yields toward a parity with money rates.

2. *Declining Commodity Prices.*—With the average lower than at any time since 1921 and with important staples such as wheat, cotton, sugar, coffee, rubber, copper and others back to or below pre-war levels, this development is strongly bullish on bonds because it means: (a) an increase in the dollar's purchasing power, hence proportionately greater value for the fixed dollar income derived from bonds; (b) lessened capital requirements for the financing of manufacturing and trading operations with a corresponding increase in capital available for other forms of investment.

3. *Low Prices and Generous Yields.*—These now prevail for all classes of bonds except for the very highest grade issues like United States government and municipal bonds which, because they are normally more sensitive to changes in money market conditions than corporation bonds, have already discounted to a large extent, the prevailing money ease.

4. *Passage of the Speculative Craze for Common Stocks.*—This has brought an increasing appreciation of the principle that a sound investment program should be built around carefully selected bonds and preferred stocks with only the "marginal" portion of the investment fund in speculative securities. The effects of this change in sentiment will be to divert a large aggregate of capital savings from the stock market into the bond market.

5. *Increased Equities Back of Good Bonds.*—This arises from the fact that during the last four or five years an unprecedented amount of new financing has been done by the sale of common stocks. Furthermore, equities have been built up by plowing back surplus earnings accumulated during the recent extended period of prosperity and in many cases, as a result of conservative common stock dividend payments. This is especially true of public utility bonds.

6. *Large bank reserves, which accentuate the ease in credit and indicate that it will be prolonged.*—These bank funds are going into bonds and absorbing the floating supply, thereby strengthening the market's technical position.

7. *Potentially Increased Institutional Demands for Utility Bonds.*—As a result of liberalized laws in wealthy states like New York, savings banks are now permitted to invest a larger percentage of their funds in such bonds.

8. *Consolidations.*—By mobilizing greater assets and earning power, the gigantic consolidation movement that has been in progress over the last several years has strengthened and fortified the position of many bonds, notably, junior bonds.

9. *Great Progress in the Science of Large-Scale Corporation Management and Financing.*—This has led to increased operating efficiency and thereby a higher credit standing for numerous companies which otherwise might have found it difficult to meet the stress of competition.

10. *Probability*, in the opinion of leading economists and advisory organizations, that the worst of the business depression is over and that a recovery will have definitely set in by next fall. A recovery in business would be particularly favorable to more speculative bonds such as debentures and convertibles.

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Ontario's Hydro Revenue Almost $40,000,000

THE TOTAL REVENUE DERIVED in 1929 from the operation of all hydro properties, including Hydro-Electric Railways and the municipalities' distributing systems, was $39,969,624, according to the annual report of the Ontario Hydro-Electric Power Commission. At the end of the fiscal year there were 37,000 rural customers taking power over 4,845 miles of line, 1,044 miles of which was constructed during 1929.

Utility Preferreds Show Remarkable Stability

AGAINST A DECLINE OF fifteen points in the past year by the general list of preferred stocks, utility preferreds have lost only a point, on the average, say Stone & Webster and Blodget, Inc. Their analysis covers the New York Stock Exchange list. From an average of 84 in August, 1929, utility preferred stocks declined to 78 in the post-slump period of December and January, but recent fluctuations have not affected the maintenance of the average at 83 after a high of 85. All of the 465 preferred stocks listed on the New York Stock Exchange and the 62 preferred stocks of public utility companies are used in compiling the average market price over a twelve-month period.

Average Prices of Preferred Stocks

1929-1930	465 Issues, All Categories	62 Public Utilities Issues
August	87	84
September	81	83
October	80	82
November	75	79
December	74	78
January	73	78
February	75	81
March	76	82
April	78	84
May	77	85
June	77	85
July	72	83

The decline of utility issues from 84 to 83 represents a depreciation of 1.2 per cent, while the decline of all preferred stocks from 87 to 72 represents one of 17.3 per cent, says the analysis.

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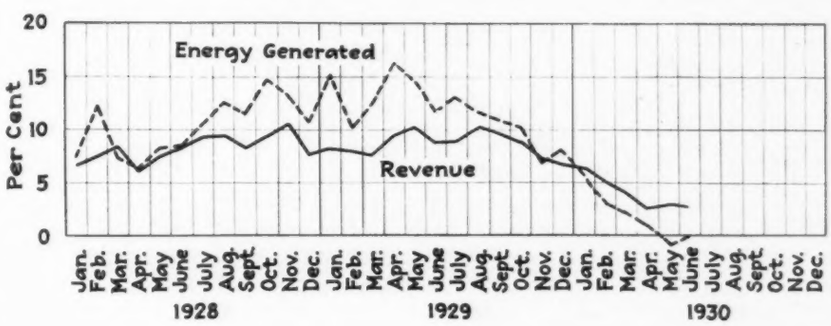
June Output Same as Last Year


20
15
10
5
0
Per Cent
Energy Generated
Revenue
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1928
1929
1930

THE average daily demand for electricity during May and June was about the same as during the same months in 1929 and apparently shows that the decrease in the demand for electricity has probably ceased. There are indications that about the normal seasonal increase in demand will probably be shown in the months to follow, according to the monthly report on energy generated by public utility power plants in the United States just issued by the U. S. Geological Survey. The total output for June of this year is given as 7,748,476,000 kw.-hr., practically the same as in June, 1929. The average daily production was 258,300,000 kw.-hr., the same as the daily output for May. The decline in the daily production of electricity by the use of water power from May to June was small, even though drought conditions throughout the country increased during June.

Business News and Markets

Few Tariff Changes Affect Electrical Manufacturers

POSSIBLE effects on electrical manufacturers of the new tariff law are outlined by the tariff committee of the National Electrical Manufacturers' Association in a report to the board of governors of the association dated August 4, 1930.

The pertinent portions of this report are as follows:

"The important change is the insertion of the new paragraph 353, prepared as a result of the work of our committee, which for the first time definitely segregates the bulk of electrical products in terms so clearly stated that there can be little opportunity for misinterpretation. This paragraph is worded as follows:

Paragraph 353.—All articles suitable for producing, rectifying, modifying, controlling, or distributing electrical energy;

Electrical telegraph (including printing and typewriting), telephone, signaling, radio, welding, ignition, wiring, therapeutic, and X-ray apparatus, instruments (other than laboratory), and devices; and

Articles having as an essential feature an electrical element or device, such as electric motors, fans, locomotives, portable tools, furnaces, heaters, ovens, ranges, washing machines, refrigerators, and signs;

All the foregoing, and parts thereof, finished or unfinished, wholly or in chief value of metal, and not specially provided for, 35 per centum ad valorem.

Involves reclassification

"In the tariff act of 1922 the intention of Congress was clearly to classify electrical products in general under the basket clause of the metals schedule at 40 per cent duty, but a new definition of 'machines,' adopted by the courts, resulted in most of this material being imported under the heading of 'machines' at a duty of 30 per cent. The new paragraph, therefore, removes all uncertainty as to classification and provides a rate somewhat less than we had requested but greater than actually had been applied in most instances in the past.

"The wording of this new paragraph is, also, carefully arranged to make proper provision for the duty on parts of electrical devices. Under the old law, parts of machines were imported at the same rate as complete machines, namely, 30 per cent, irrespective of the material from which they were made, and porcelain bushings, for instance, for oil circuit breakers were imported at that rate of duty instead of 60 per cent, which should have applied in accordance with the rate of articles composed of porcelain. The new paragraph covers parts of electrical devices only where they are made wholly or in chief value of metal. If the material of which they are chiefly composed is other than metal, they will, therefore, automatically be classified under their proper paragraphs.

"A few other changes have been made in the new law which affect products in which electrical manufacturers are interested, some increases and some decreases, but these are confined in each instance to a limited line of products."

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Maytag Earnings Off

NET PROFITS OF THE Maytag Company for the six months ended June 30 were $1,382,927, or 44 cents a share of common stock, against $3,236,121, or $1.55 a common share, for the first half of 1929.

The net profit for the quarter ended June 30 was $991,150 after above charges, equal to 40 cents a share on 1,617,922 common shares, comparing with $391,776, or 4 cents a share, on 1,617,822 shares in preceding quarter and $1,915,153, or 96 cents a share, on 1,608,795 shares in June quarter of the previous year. Sales for first six months of 1930 were $9,073,503, against $13,106,283.

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Packard Electric Sales

SALES OF THE Packard Electric Company for the six months ended June 30 totaled $1,302,857, against $2,023,799 for the first half of 1929. Net profits for the period amounted to $81,333, against $293,041 for the first half of last year.

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Westinghouse Suit Against Ingersoll-Rand

COUNTER SUIT AGAINST THE Ingersoll-Rand Company for an alleged infringement of the Karl Baumann patent has been initiated by Westinghouse Electric & Manufacturing Company. Ingersoll-Rand Company recently entered a similar suit against Westinghouse, charging infringement of the Banzel patent for condensers. Westinghouse also raised the issue that the Banzel patent is invalid on the ground that all of its essential elements have been

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DELINQUENT ELECTRICAL ACCOUNTS

(National-Electrical Credit Association)

Number of Accounts Reported

Division	June 1929	June 1930	Per Cent Increase or Decrease	Six Months 1929	Six Months 1930	Per Cent Increase or Decrease
New York	212	277	+30.7	1467	1921	+30.9
Middle & Southern Atlantic	195	135	—30.7	975	1064	+ 9.1
New England	143	95	—33.5	969	799	—17.5
Central	673	589	—12.5	3892	4731	+21.6
Total	1223	1096	—10.4	7303	8515	+16.6

Total Amounts Reported

Division	June 1929	June 1930	Per Cent Increase or Decrease	Six Months 1929	Six Months 1930	Per Cent Increase or Decrease
New York	$38,632	$51,016	+32.	$292,571	$336,368	+15.
Middle & Southern Atlantic	24,499	15,456	—36.9	140,832	165,173	+17.2
New England	21,822	9,554	—56.2	131,302	119,820	— 8.7
Central	83,771	81,795	— 2.3	485,523	664,520	+36.9
Total	$168,724	$157,821	— 6.5	$1,050,234	$1,285,881	+22.4

generally known and used prior to the granting of the patent in 1925.

In the counter suit Westinghouse Electric & Manufacturing Company asked for an injunction against Ingersoll-Rand Company, as the latter company had done against Westinghouse in the previous case.

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Electrical Manufacturers See Improvement in Second Half Year

WHAT does the second half year hold in store for electrical manufacturers? Official reports for the first half year's operations of a representative group give a fair picture of the situation. This may serve as a gage of what is ahead.

In brief, the situation is this. Rate of production in manufacturing plants is about 6 per cent below that at about this time last year, but is slightly higher than it was at the beginning of the current year. Taking half-year periods, the output of the small group shown is 2.8 per cent below that of the first half of 1929. The group represents a fair proportion of the industry and is probably representative.

What is the outlook? Some of the largest utilities have announced that the large-scale construction programs laid out last spring will be carried into effect to the letter and some will be on a larger scale during the second half year than anticipated. A careful observer in touch with a large number of Eastern manufacturers anticipates a very definite improvement in equipment orders within 30 or 60 days. New appliances are constantly being introduced and sales efforts in this field are bound to bring substantial results. Furthermore, railroad electrification is proceeding apace and will give rise to a very substantial volume of business during the second half year.

While much is said of possible retaliation by certain foreign countries to United States tariff measures, there is little indication that there is much to fear in this direction. The largest market at the present time is Canada, and while the success of the Conservative party in the recent elections suggests higher tariffs against the United States goods, there is little indication as yet that the electrical industry will be materially affected. Among the next largest markets are Great Britain, Argentina, Australia and Mexico. In each one of these cases the outlook is for expansion in export trade rather than restriction.

All in all, the outlook for the second half year in the equipment, accessories and appliance field is very satisfactory.

Sales (or Profits) by Electrical Manufacturers (Half Year)

	1930	1929
General Electric	$197,229,346	$194,353,307
Westinghouse	93,022,036	99,927,790
Johns-Manville	25,561,918	29,591,640
Allis-Chalmers	29,480,951	28,022,998
Timken Roller Bearing	6,120,023	8,449,198
Cutler-Hammer	802,807	1,123,152
Manhattan Electrical	3,722,891	4,813,560
	$355,939,972	$366,281,645

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Manhattan Electrical Shows Loss

THE REPORT OF THE Manhattan Electrical Supply Company, Inc., now American Machine & Metals, Inc., and subsidiaries shows a loss of $224,569 for the first half year, compared with a profit of $67,094 for the first half of 1929. The consolidated income account for the past two years follows:

	1930	1929
Net sales	$3,722,891	$4,813,560
Costs	2,817,353	3,552,850
Gross profit	$905,538	$1,260,710
Miscellaneous inclusive	182,161	157,052
Total Inclusive	$1,087,699	$1,417,762
Expenses	1,007,867	1,106,364
Depreciation	124,252	129,877
Interest	83,013	92,592
Idle plant upkeep, etc.	97,136	21,835
Loss	$224,569	*$67,094

*Profit before federal taxes

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Kelvinator Earnings Rise Sharply

EARNINGS OF THE Kelvinator Corporation for the nine months ended June 30 were as follows:

	1930	1929
Gross profit	$6,139,627	$4,871,780
Total operating expenses	3,528,588	3,073,037
Operating profit	$2,611,038	$1,798,743
Other deductions	422,607	497,085
Profit before tax	$2,188,430	$1,301,657
Provision for income tax	75,465	.....
	$2,112,964	$1,301,657

For the quarter ended June 30, 1930, net profits, before a provision for possible federal income taxes, were $1,489,933, which compares with a similar profit for the same quarter of 1929 of $1,441,803.

Sangamo Electric Earnings Down

NET PROFITS OF THE Sangamo Electric Company, after charges and taxes, for the six months ended June 30 amounted to $197,705. This is equivalent to $1.30 a share on common stock and does not include the profits of the British and Canadian subsidiaries. Net sales of the company during 1929 were $3,545,150 and net earnings after costs and depreciation were $385,280, the equivalent of $4.12 per common share.

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Cutler-Hammer Shows Decline in Earnings

NET PROFITS OF Cutler-Hammer, Inc., for the six months ended June 30 were $802,807, against $1,123,152 for the first half of 1929. Shipments during the six-month period were $5,209,968, against $5,875,315 in the first half of 1929.

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TRADE BRIEFS

South Bend engineering department of the Westinghouse Electric & Manufacturing Company has been moved en masse to the Cleveland works of the company.

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Following the usual practice of having all vacations at the same time, Leeds & Northrup Company of Philadelphia has announced that the plant will close for a period of two weeks in August (from the 9th to the 23d, inclusive) except for a skeleton organization to care for emergency requirements.

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Davis Emergency Equipment Company, Ltd., with headquarters in New York City, manufacturer of emergency equipment, has established Western headquarters in San Francisco, Calif. The company was formerly represented in San Francisco by the Bullard-Davis Company of California. Herbert Brendlen, vice-president, will be in charge of the Western headquarters.

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New York Metal Prices

	July 30, 1930 Cents per Pound	Aug. 6, 1930 Cents per Pound
Copper, electrolytic	11	11
Lead, Am. S. & R. price	5¼	5¼
Antimony	7¼	8-8¼
Nickel, ingot	35	35
Zinc, spots	5.10	4.80
Tin, straits	29¾	30.10
Aluminum, 99 per cent.	23.30	23.30

Market Conditions

EQUIPMENT buying is still on a hand-to-mouth basis. Volume in the Eastern district is well up to normal both in appliances and small equipment. Fractional-horsepower motors are active in New England.

——PACIFIC COAST BUYING HAS DROPPED BACK TO NORMAL. Prices of scheduled material have declineed 5 to 15 per cent.

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EASTERN

—SIZABLE ACCOUNT CONTINUES *under good impetus in the Eastern district for this season of the year and incoming inquiries indicate a reasonable continuance of commitments for the next fortnight.*

—JOBBERS OF ELECTRICAL SUPPLIES *say that trade is extremely quiet and that hand-to-mouth orders show no signs of developing into more substantial account. Electric fans and electric refrigerators are recording good sales, in some instances paralleling those of this time last year.*

Two important awards have been secured by the Westinghouse Electric & Manufacturing Company for central-station and industrial equipment. The first noted covers heavy oil-filled switchgear apparatus for the State Line Generating Company, including nineteen 25,000-volt double bus bays, controlling two double-winding generators, eight bus section and reactor circuits, with accessories, costing about $1,000,000. The second order is for equipment for steel mill service for the United States Steel Corporation, comprising two 5,000-hp. reversing motors, one similar unit of 2,500-hp. rating, one 10,500-kw. flywheel motor-generator set, with complete auxiliary apparatus, for universal slab mill operation, totaling approximately $750,000. An Eastern manufacturer has secured a contract for a 3,500-kw. turbo-generator unit, with switchboard and accessories, for a municipal installation in North Carolina, the award for condensing apparatus being placed with a New York maker.

Industrial account seems to be making ready to launch some ambitious programs with the advent of the fall season, particularly in regard to chemical, oil and affiliated lines of activity, as well as iron and steel, metal-working and allied interests. Proposed chemical and oil projects now announced will total over $10,000,000, while the iron and steel plants will expend over $75,000,000 for expansion. An aircraft maker in Connecticut has placed an order with a New York manufacturer for airplane impellers to cost about $30,000. The Canadian Copper Refineries, Ltd., has given a contract for 120 motor units of small and large rating up to 110 hp. for a mill installation. The Algoma Steel Corporation has closed for a motor-generator set for steel mill service, including complete ventilating apparatus, circulating oiling system, and auxiliaries, totaling about $250,000.

CONSTRUCTION PROJECTS

Bell Telephone Laboratories, New York, plan research and experimental plant near New Providence, N. J., to cost over $500,000. Ford Motor Company, Detroit, Mich., has asked bids for assembling plant at Buffalo, N. Y., to cost $1,500,000. Superintendent of Lighthouses, Staten Island, N. Y., will receive bids until September 10 for ten four-panel flashing lenses. Public Service Electric & Gas Company, Newark, N. J., plans addition to power substation at Irvington, N. J., to cost over $200,000. Perth Amboy, N. J., contemplates ornamental lighting system. Department of Public Works, Philadelphia, Pa., will receive bids until August 13 for two 1,800-hp. electric motors. Gulf Refining Company, Pittsburgh, Pa., contemplates oil storage and distributing plant at Memphis, Tenn., to cost over $200,000. Hercules Powder Company, Wilmington, Del., has filed plans for addition to laboratory and plant to cost over $1,000,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until August 26 for dry and flashlight batteries (Schedule 3884.)

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SOUTHEAST

—MERCHANDISE AND JOBBING LINES *in the Southeast report distinct signs of improvement in business, and July, almost without exception, was reported as a better month than June.*

A Georgia engineering firm reports the purchase of a switchboard to the amount of $4,800 for the federal penitentiary at Atlanta, Ga. This institution will let contracts and buy materials for additions to its textile mill to the amount of approximately $25,000 within the next ten days. An engineering firm reports plans for construction of a "whiteway" and underground distribution system at Agnes Scott College, Atlanta, Ga., and electrical work in connection with the central heating plant at the Florida College for Women, this last item amounting to approximately $3,000.

A Georgia construction company reports the purchase of transformers amounting to $11,000, and a Georgia utility company purchased poles to the amount of $1,400, fuses $1,400, small transformers $2,750, circuit breakers, lightning arresters and bushings amounting to $1,200, and wire $14,000.

CONSTRUCTION PROJECTS

Muddleston Mahogany Company, South Norfolk, Va., plans lumber mill to cost about $100,000. Tri-State Refining Company, Richmond, Va., contemplates oil refining plant to cost $100,000. Richmond, Fredericksburg & Potomac Railroad Company, Richmond, Va., has filed plans for a two-story storage and distributing plant to cost $100,000. Monongahela West Penn Power Company, Fairmont, W. Va., has authorized installation of ornamental lighting system at Mannington, W. Va.

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MIDDLE WEST

—A MORE OPTIMISTIC FEELING *is in evidence in the Middle West, although business continues to mark time. The major activities, steel, railroad, automotive and electrical industries, have improved their positions somewhat.*

—RESUMPTION OF MANUFACTURING *in the automotive field is looked upon as a favorable indication of the return of business. Carloadings are fairly large and employment has increased slightly. Reports of the large mail order houses indicate a normal volume of business, although retail trade is still quite slow.*

The various utility companies are proceeding conservatively, with a resumption of work scheduled to start this month and to increase each month until November, at which time it is expected that full operations will be scheduled. The demand for apparatus is somewhat light, although there has been a good demand for distribution equipment. Several construction orders aggregating $75,000 were placed this week. Railroad business is holding up well, while industrial activity continues spotty. The unusually hot weather has stimulated sales of electric fans and refrigerators to a large extent.

CONSTRUCTION PROJECTS

Detroit Edison Company, Detroit, Mich., will make extensions and improvements in steam-operated power plant at Conners Creek, to cost over $5,000,000. The Richter Food Products Company, Chicago, Ill., will proceed with a factory unit to cost over $400,000. Car Service, Inc., Chicago, Ill., will build a multi-story service, repair and garage building to cost $200,000. Chicago, Ill., contemplates a bond issue of $2,000,000, for extensions and improvements in street

lighting system. Indiana & Michigan Electric Company, South Bend, Ind., will build a power substation. Ohio Edison Company, Akron, Ohio, plans transmission line to Toronto, Ohio, and vicinity, to cost over $500,000. Minot and Lakota, N. D., contemplate ornamental lighting systems. Northwestern Public Service Company, Huron, S. D., will soon take bids for power plant addition at Yankton, S. D., to cost $100,000. Duluth and St. Paul, Minn., plan ornamental lighting systems. Lincoln Telephone & Telegraph Company, Lincoln, Neb., plans addition to equipment storage and distributing plant to cost over $100,000.

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PACIFIC COAST

—POWER COMPANY PURCHASING *has dropped again to a fair level after recent large orders for machinery and maintenance material. Contractors' business is only fair and prices on schedule material, rubber-covered wire and flexible steel conduit have dropped from 5 to 15 per cent, putting the entire list of building staples on a lower basis.*

—RANGE AND RADIO SALES *are good, though the latter is still far from the peak which is predicted for September and October. Westinghouse reports two carloads of ranges each for Los Angeles and Seattle.*

Special lighting installations are still the most active contracting branch, including a $30,000 award for lighting the Oakland ball park, a 62-floodlight job for a Stockton stadium, a street-lighting award of $12,000 for Sacramento, and an estimated job of $40,000 for Santa Barbara. Other proposed street-lighting installations cover San Rafael, Eureka, Glendale, Santa Cruz, Porterville, and Livermore, typical jobs being 56 duplex for Porterville and 70 single and duplex assorted for Redwood City. Miscellaneous power installations have included a $15,000 General Electric tower equipment for San Francisco, half a carload of wire and a $2,500 pumping line for Ukiah, two panels size 100 and 150 hp. for Patterson, a $150,000 addition to the Pasadena plant, a 60-mile irrigation line for the Arizona Casa Grande district, two carloads of 45-ft. poles for San Mateo, and an as yet unawarded order for 500,000-circ.mil, three-conductor, 11,000-volt sector cable valued at about $20,000. Application for a preliminary permit for the proposed 303,000-hp. hydro-electric project in northwest Washington have been filed with the power commission in Washington, D. C., by the Great Northern Power Company of Seattle, holder of power sites on several rivers in Snohomish County. Puget Sound Power & Light Company plans expenditure of $10,000 in South Bend, Wash., for an auxiliary plant and has applied for a franchise for transmission lines in four sections of Whatcom County. This company also plans immediate extension of transmission lines in eastern Pierce, Thurston and Lewis Counties, over territory comprising 1,600 square miles.

Approximately $25,000 worth of miscellaneous switchgear was reported sold. St. Regis Paper Company, the recent purchaser of Union Bag & Paper Company's Tacoma pulp mill, plans doubling Tacoma plant by constructing a $2,000,000 paper mill. As heretofore reported, this company plans a $250,000 paper conversion plant in Seattle. A $3,000,000 cement plant is planned in Portland, Ore., by the Wallowa Lime & Cement Company and orders for machinery and electrical equipment for a $250,000 insulation board plant in Victoria will be placed in September.

CONSTRUCTION PROJECTS

Southern California Edison Company, Los Angeles, Calif., will build a power substation at Santa Barbara, Calif., to cost $80,000. General Petroleum Corporation, San Francisco, Calif., contemplates oil refining plant at Torrance, Calif., to cost over $7,000,000. Southern Sierras Power Company, Riverside, Calif., plans transmission line from Calipatria to Blythe, with power substation at latter place, to cost $375,000. Puget Sound Power & Light Company, Seattle, Wash., plans power substation at Snohomish, Wash. Wood & Iverson Lumber Company, Hobart, Wash., contemplates lumber mill to cost over $200,000. Dillon, Mont., contemplates ornamental lighting system. Electrical District No. 4, Casa Grande, Ariz., has authorized construction of transmission line to cost $250,000. Tucson, Ariz., contemplates ornamental lighting system.

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SOUTHWEST

—THE RECORD-BREAKING *hot weather of the past week has contributed to other causes in reducing the volume of sales in all lines of the electrical industry.*

—MANUFACTURERS REPORT THAT SALES *of the smaller sizes of apparatus are not so bad, considering the general depression and the fact that we are between seasons.*

All buying is for the actual necessity of the hour. Budgets are being cut down. One large distributing company admits cutting its budget in half. No contracts of importance have been closed during the week. The only orders pending are for additions to power plants of two municipal companies in Missouri, one of which will amount to $15,000 and the other to about $50,000.

CONSTRUCTION PROJECTS

Independence, Mo., plans early call for bids for equipment for extensions in municipal power plant to cost $113,000. Kansas City, Kan., plans extensions and improvements in municipal light and power plant. Oklahoma Carbon Industries, Sayre, Okla., contemplates carbon black plant to cost over $300,000. Crossett Chemical Company, Crossett, Ark., has authorized local plant to cost over $150,000. Crawford-Austin Tent & Awning Company, Waco, Tex., contemplates factory to cost over $300,000. Dallas Power & Light Company, Dallas, Tex., will make extensions in transmission lines to cost over $1,000,000. Southwestern Public Service Company, Amarillo, Tex., will make extensions in transmission lines and power substations to cost $250,000. New Orleans Air Transport Company, New Orleans, La., contemplates aircraft plant to cost over $200,000. Opelousas, La., contemplates ornamental lighting system.

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NEW ENGLAND

—DURING THE PAST WEEK *electric equipment orders were confined principally to small motors, which are maintaining a steady trend in sales. A number of interesting orders for groups of fractional-horsepower motors are to be placed soon. One prominent manufacturer reports that for the previous month orders for power control apparatus reached a volume greater than for any month to date.*

Heavy equipment for power plants and substations recently placed include a 100,000-kva. synchronous condenser and control equipment. Orders for transformers are spotty. Recently two 15,000-kva. auto-transformers and three 10-kw. station transformers were ordered for a Massachusetts substation. Line materials have been active and sales of this equipment continue to show encouraging activity, with poles, crossarms and line hardware of outstanding interest. Materials for underground distribution lines are receiving attention; one project to cost about $110,000 is planned for southern New England.

Electric arc-welding apparatus sales for the past month, according to a representative company, reached the highest monthly total so far this year. Another electrical specialty attracting interest is the electric-controlled clock; one group of central stations reported more than 40 orders for the past week. Official reports from Maine companies point to good business conditions in that district, which have resulted in an increase of about 400,000 kw.-hr. per week over the output for a corresponding time in 1929.

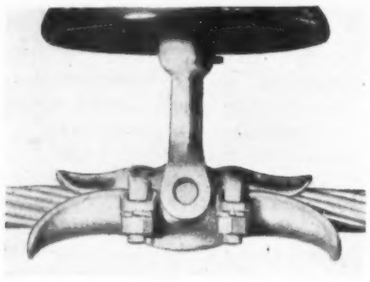
CONSTRUCTION PROJECTS

Adams Paper Company, Baldwinville, Mass., is said to be planning plant addition to cost over $100,000. Holyoke Water Power Company, Holyoke, Mass., plans hydro-electric power plant to cost over $150,000. Trumbull Electric Manufacturing Company, Plainville, Conn., is reported planning branch plant near Oakland, Calif., to cost over $150,000.

New Equipment Available

Trunnion Clamps for Cable Suspension

LIGHT-WEIGHT TRUNNION TYPE suspension clamps of copper-bearing forged steel for conductors ranging in sizes from $\frac{1}{4}$ in. to $2\frac{1}{4}$ in. are announced by the Lapp Insulator Company, Le Roy, N. Y. The clamp has a locking device utilizing a lock washer between serrated teeth on the lock and nut body ears so



that the nut once in place cannot be loosened by continued vibration. There are no U or J bolts, the clamps being forged integral with the keeper. A substantial $\frac{7}{8}$ in. square section is provided for attaching any type of arc protection device.

The trunnion clamp will aid materially in gentle handling of the conductor to the end that less local bending stress will have to be absorbed by the conductor in the clamp, according to the manufacturer.

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Synchronous Motors from 20 to 10,000 Hp.

SYNCHRONOUS MOTORS WITH RATINGS ranging from 20 to 10,000 hp. in both high and low speed types are announced by Fairbanks, Morse & Company, Chicago.

These motors have a number of attractive characteristics, according to the manufacturer. They are designed with anti-friction bearings and stators with cast semi-steel skeleton frame ends of boltless, nutless and threadless construction. The entire stator core is compressed evenly by a powerful hydraulic press and under this pressure the stacking pins are welded to form a flat countersunk head, which effectively prevents loosening or shifting of the core laminations.

The starter, which is similar to the across-the-line starter for induction motors, has a relay-actuated automatic field switch which closes the field as the motor approaches synchronous speed. This switch automatically opens when the motor stops.

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Manual Switch for Pilot Control

MOTOR-DRIVEN PUMPS, COMPRESSORS, and similar machines which are controlled by an automatic device such as a float switch, pressure switch, time clock, etc., often require some means of starting and stopping the motor manually. For this purpose Cutler-Hammer, Inc., Milwaukee, Wis., has developed a new three-position pilot switch. The operating lever can be placed in either the "automatic," "off" or "manual" position. When turned to "automatic" the automatic pilot device is in circuit and normal automatic operation is obtained. With the lever in the "off" position the pilot circuit is opened and the motor cannot be started from any other control point. Turning the lever to the "manual" position closes the control circuit direct and the motor will run continuously, regardless of any other control devices, as long as there is operating voltage on the line.

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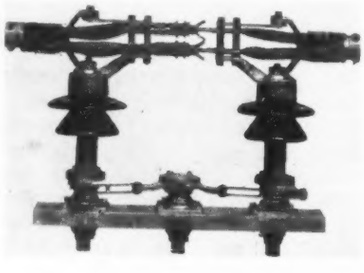
Disconnect Switch Design Facilitates Operation

FULL-FLOATING, ADJUSTABLE CONTACTS and swivel terminal connectors, which, according to the manufacturer, insure ease of operation from the center control bearing to which the interlocking operating mechanism is connected, are the features embodied in a new line of high-voltage, heavy capacity, horizontal center break, gang-operated switches



announced by the Delta Star Electric Company, Chicago. The switches are designed for mounting on the top or sides of outdoor substations.

Clutch Type Motor Starts Heavy Loads

HIGH STARTING TORQUE AND constant starting current, regardless of the load, are the claims made for a $\frac{1}{4}$-hp., 1,725-r.p.m., split-phase motor identified as the type CAH clutch motor, announced by the Westinghouse Electric & Manufacturing Company.

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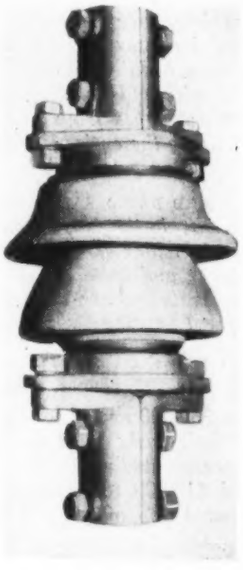
High-Strength Insulator for Gang-Switch Shafts

A DOUBLE PETTICOAT, HIGH-STRENGTH INSULATOR section for use in insulating the shafts of gang-operated switches has



been announced by the Champion Switch Company, Kenova, W. Va. The unit is equipped with fittings permitting quick and easy attachment to the switch shaft. Its use provides additional safety in case of faulty grounds or poor ground connections to switch bases.

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Across-the-Line 2,300-Volt Starter

SQUIRREL-CAGE AND SYNCHRONOUS MOTORS may be started across the line by a 2,300-volt, full-voltage magnetic starter which is announced by the Electric Controller & Manufacturing Company, Cleveland. This starter, which is built for reversing, non-reversing and plugging applications, is complete with overload relays and a self-contained potential transformer which delivers 220 volts for the control circuit.

This device can also be used to control the primary of slip-ring motors.